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CRANIOSTENOSIS[1]

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THE term "craniostenosis," or "contraction of the skull," in its general meaning is applied to all conditions where a disproportion exists between the size of the skull and its contents. This is found, for example, with tumors of the brain or meninges and with hydrocephalus.

In the more restricted sense, however, the name "craniostenosis" is applied only to those anomalies which lead to a diminution in the actual size of the skull cavity. Such a contraction is caused most commonly by premature closure of the sutures of the skull. Normally, the obliteration of these sutures does not occur until the later decades of life, therefore, every closure of these sutures in the earlier decades must be considered as premature. Suture closure is of practical significance, however, only when it takes place during intra-uterine life, or in the first year of post-fetal life. During this period the growth of the skull is possible on account of the suture spaces. Later the skull develops only by periosteal apposition and resorption, just as in the basal synchondroses.

Premature synostosis of the sutures is to be regarded as a congenital malformation, which may often occur hereditarily. The earlier the synostosis takes place, and the greater the number of sutures involved, just so much more marked is the degree of skull contraction. When all the sutures are closed the skull remains so small that it resembles a microcephalic skull. The closure of only single sutures may often cause no contraction at all, since those which remain open take on a compensatory function. This compensation is seen externally in the irregular development of the skull in various directions.

The nomenclature of the different types of craniostenosis is based upon the character of the skull deformity. This, in turn, is determined by the relative importance of the elements of contraction or compensation. Thus we have "tower skull" (oxycephaly), "boat skull" (scaphocephaly), "flat skull" (plagiecephaly), "pseudo-microcephaly," etc.

The clinical symptoms of craniostenosis are dependent upon two factors: (1) the deformity, and (2) the contraction of the skull. The latter causes headache, papilledema, epileptoid attacks, psychic disturbances, etc., just as would any other kind of disproportion between the size of the skull and its contents. As for the deformity itself, there are, first of all, very definite esthetic and cosmetic disadvantages for the patient (Schüller). The abnormal height or the abnormally small size of the skull are in themselves disfiguring. The unfavor-

[1]Read before the Second International Radiological Congress, Stockholm, July, 1928.

able impression which these patients make upon an observer is further increased by their having a forehead which is either steep, protrudes too much, or recedes abnormally. The base of the nose may project, the nose itself may be too large, the eyes may be either too close together or too far apart, may protrude markedly, or may have a bad squint. The jaws may be deformed and have a very bad occlusion. Aside from the facial bones and the calvarium, the base of the skull may also show serious deformities. The floor of the middle cerebral fossa is frequently depressed to a considerable extent. As a result of the deformity of the basal bones the cranial nerves are often pulled, kinked, and compressed, so that serious disturbances of vision, hearing, and smell may take place.

The roentgen appearances enable us to determine with considerable exactness the degree of contraction and deformity of the skull, including the basal bones (Schüller, Greig). The degree of contraction is estimated by the extent of the impressiones digitatæ and the juga cerebralia. The amount of deformity is judged by the degree of depression of the floor of the middle cerebral fossa (Figs. 1 and 2).

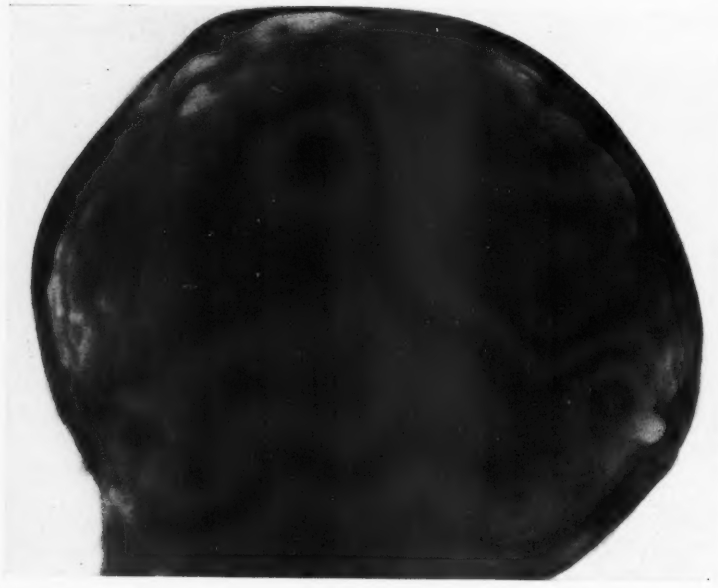


Fig. 1. Oxycephaly in a boy aged 6. Abnormally high calvarium, absence of sutures, strongly marked impressiones digitatæ, depression of the middle cerebral fossa.

The condition of the fluid spaces in the craniostenotic skull is markedly variable, and of considerable practical significance. The distribution of these spaces can be determined by the roentgen examination, especially by means of contrast filling with air or lipiodol. Most commonly there is a constriction of the intra-cerebral fluid spaces, so that a "dry brain" is produced. On the other hand, the extra-cerebral spaces, especially the basal cysterna and the subarachnoid spaces, appear to be filled to a normal extent. In rare cases there may be an abnormal widening of the fluid spaces—a combination of craniostenosis with hy-

drocephalus. The presence of this combination may be determined roentgenologically without any contrast filling, from the widening of the sella turcica. With uncomplicated craniostenosis the sella turcica appears to be entirely normal, in spite of marked pressure atrophy of the inner table of the skull.

The roentgen examination also permits a differential diagnosis between craniostenotic skull deformities and other types of form anomalies of the skull, as, for example, microcephaly vera, pseudo-microcephaly, hydrocephalus and either generalized or local hyperostosis of the skull.

Finally, the roentgen appearances give the necessary facts for the choice of therapy in the various disturbances present with craniostenosis. Among these, the disturbances of vision seem to be the most important. Surgical operation is the commonest method of treatment, especially decompression by means of a large flap in the parietal region (Figs. 3 and 4). More recently Reyher (cited by Krause) has advocated decompression in the posterior cerebral fossa, by making a flap in the posterior wall of the cerebellar fossa. For the choice of this operation, however, the indications seem very indefinite. It will be necessary to have an extensive practical experience with a great number of these cases before the relative advantages of the methods can be determined. In those cases where there is a combination of craniostenosis and hydrocephalus the usual methods employed in the operative treatment of hydrocephalus may be considered (Denk).

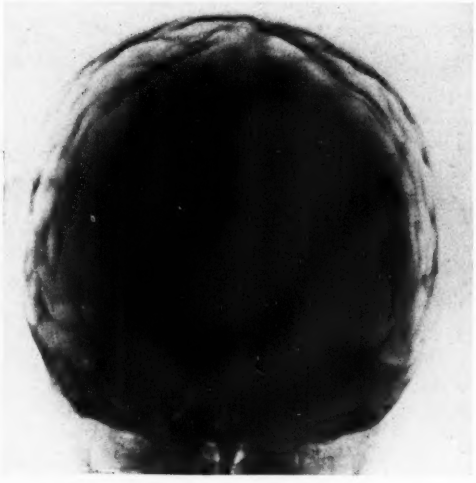
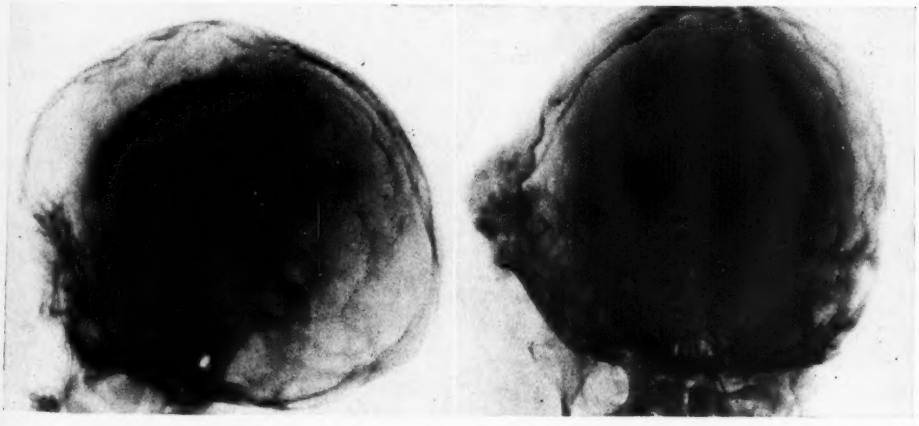


Fig. 2. Oxycephaly in a boy aged 7. Deepening of the impressiones digitatæ, absence of sutures, depression of the petrous pyramids.

Since the type of craniostenosis produced by premature synostosis of the sutures is to be regarded as a congenital malformation,



Figs. 3 and 4. Oxycephaly in a 12-year-old boy. Decompression in right parietal region two years previously, partial regeneration of the skull wall, prolapse of brain substance.

and frequently hereditary, it is not surprising that in the most extensive cases of this deformity other skeletal anomalies are found, particularly in the distal portions of the extremities. According to the classification of Apert such malformations are grouped under the name of "acrocephalosyndactylia" (Fig. 5). In recent years considerable investigation of this group has been made by Swedish workers, particularly Gadelius and Wigert. The researches of these authors have shown that with acrocephalosyndactylia serious disturbances in mental development are always found. There is an important problem as to whether the psychic anomalies are to be construed as due to a brain defect comparable to the skull malformation, or whether the disturbance in the development of the brain is itself secondary. In the latter case the mental trouble could be possibly avoided by a timely operative attack, such as decompression. This problem is still far from being settled.

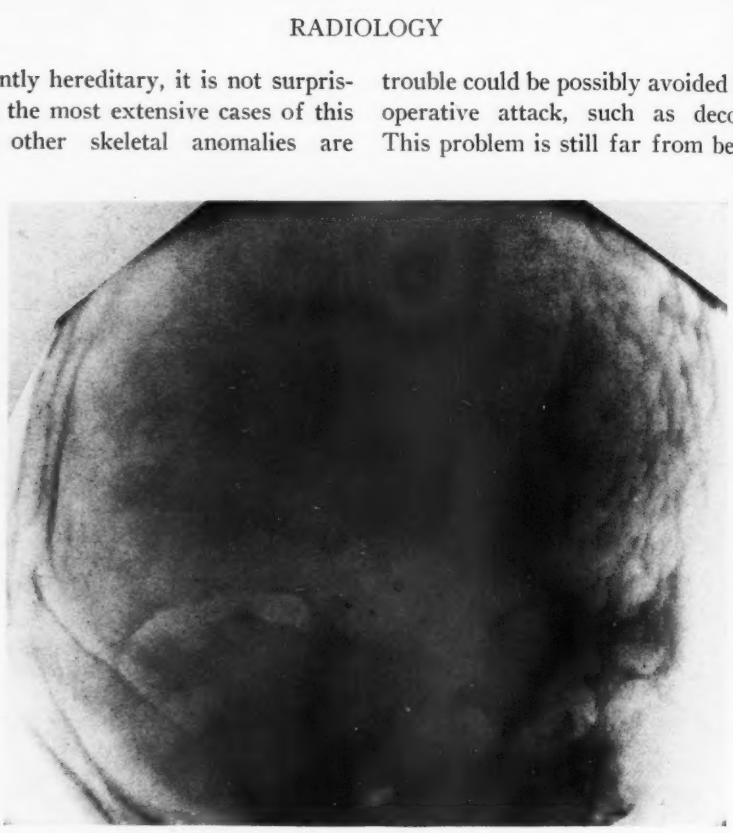


Fig. 5. Acrocephalosyndactylia, combined with hydrocephalus in a boy of 12. Abnormally high calvarium, absence of sutures, strongly marked impressiones digitatæ, shortening of the anterior cerebral fossa, depression and rotation of the floor of the middle fossa, marked enlargement of the sella turcica, atypical course of the venous sinus.

Trigonocephaly is another of the skull deformities due to premature synostosis. This condition is characterized by an abnormally narrow forehead, which projects in the median line, with a typically keel-like formation. A horizontal section of the skull shows a practically triangular outline. This deformity is produced by an early closure of the sutures in the frontal region, and its cause is thought to be a primary malformation of the brain, namely, a mild grade of arhinencephaly. Patients with trigonocephaly are almost all mentally deficient.

Another malformation apparently produced by premature closure of sutures is the condition described by Greig under the name "hypertelerismus." This is a skull deform-

ity characterized especially by an abnormally wide space between the orbits, and accompanied by disturbances of mental development.

Fig. 6. Hydrocephalus chondrodystrophicus congenitus in a girl aged 3. Abnormally high calvarium, hernia-like projections of the skull contents in the frontal region, circular constriction of the skull wall.

Finally there is a type of craniostenotic skull deformity described as "chondrodystrophia." In this condition, a shortening of the base of the skull has been produced by a premature closure of the basal synchondroses. In consequence there is a hydrocephalic enlargement of the entire vault of the skull, even in mild grades of chondrodystrophia. The most severe types of this condition are seen in those cases where there is also a premature closure of the sutures of the cranial vault of calvarium. Such skulls may show extremely grotesque forms (Figs. 6 and 7). The skull is enlarged in a hydrocephalic manner and, in addition, shows a constricting furrow extending horizontally along the side. The resulting deformity, as shown in the illustrations, has produced three spheroid segments resembling a pumpkin (hydrocephalus chondrodystrophicus congenitus, Meyer, Gruber, Dietrich-Weinnoldt).

Fig. 7. Transverse roentgenogram of patient shown in Figure 6. Marked prominence of impressiones digitæ, arch-like projections between these impressions.

In addition to the "primary" obliterations of the sutures which are to be regarded as congenital anomalies, there is also a "secondary" type of synostosis which is acquired. This may occur after traumatic injury of the suture lines (Weinnoldt), in the course of certain diseases of the skull such as rickets (Kaufmann), or in early acquired brain disturbances. Among the latter are the types seen occasionally in epileptic children (Materna, Ludewig). Since these secondary obliterations of the sutures occur practically always after birth and usually in the later years of childhood, they do not have any real influence upon the growth of the skull.

To summarize, it may be stated that the roentgen examination of the skull is of extreme importance in determining the diagnosis and prognosis of those types of skull deformity grouped under the name of craniostenosis, in the narrower sense. In addi-

tion, the various disturbances that accompany these skull anomalies may be favorably influenced by roentgenotherapy or by operative decompression.

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THE ROENTGEN RAY IN THE DIAGNOSIS OF MUCOUS COLITIS[1]

By FRED M. HODGES, M.D., RICHMOND, VIRGINIA

UNTIL recently, relatively speaking, the diagnosis of this peculiar disease, neurosis, or allergic phenomenon was dependent almost entirely upon the demonstration of numerous strings, or balls of mucus, or mucous casts of the bowel in the feces.

Frequently patients are not aware of having passed mucous casts and unless the cases are kept under observation for a considerable length of time the clinician may, even after a thorough examination, be apparently justified in a diagnosis of organic disease of one of the abdominal organs, since it is generally known that this condition in its various visceral manifestations may closely simulate organic disease—occasionally acute, but usually chronic—of almost any of the abdominal viscera. As a rule these patients will have had one or more laparotomies before a correct diagnosis is made.

For several years I have attempted to correlate the clinical and roentgen findings in definite mucous colitis without demonstrable organic pathology.

In this study it has been necessary to consider the clinical as well as the roentgeno-

[1]Read before the Radiological Society of North America, at the Fourteenth Annual Meeting, at Chicago, Dec. 3–7, 1928.

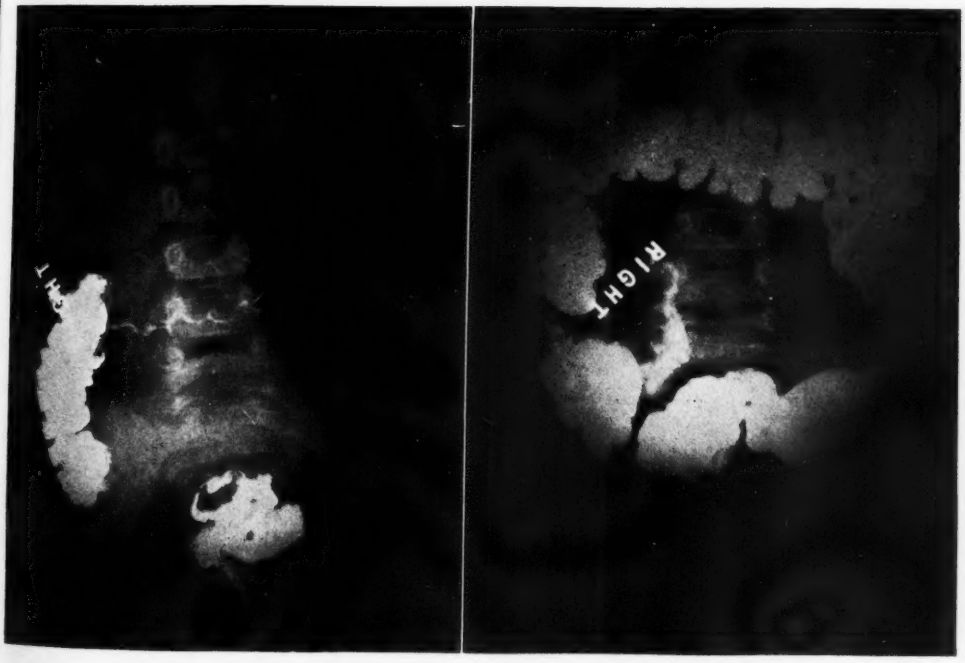

Fig. 1, Case 1. Twenty-four-hour film. Patient is girl, 4 years old. Shows definite string sign involving especially the transverse colon, splenic flexure, and descending colon.

Fig. 2, Case 1. Twenty-four-hour film. Same case as shown in Figure 1, 8 months later, showing practically a normal colon.

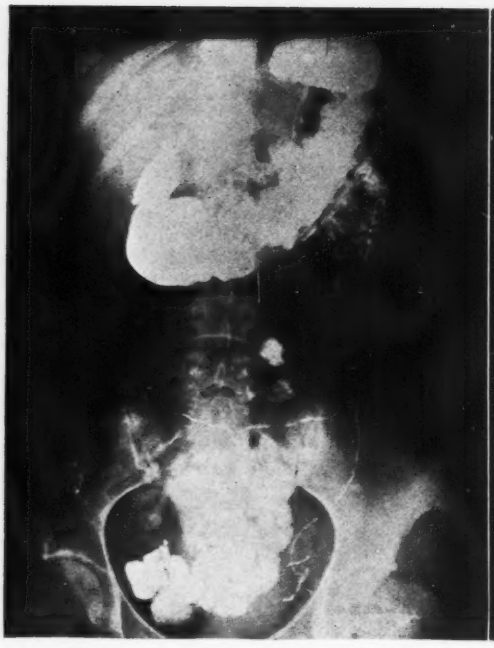

Fig. 3, Case 2. Six-hour film. Patient is woman, 26 years old. The entire colon shows a definite string sign. A second meal had been given for an examination of the stomach and duodenum.

Fig. 4, Case 2. Six-hour film, taken one year later than Figure 3. The string sign is noted only in the transverse colon.

graphic aspects of the condition for only in this way can there be a reasonable assurance of a correct diagnosis, since there is no indication for surgery and even if the abdomen is opened the colon shows no demonstrable pathology.

The clinical side of the condition will not be considered further, except to relate when the clinical and roentgen findings are or are not in accord.

In my experience, what I have considered to be mucous colitis is apparently more or less rare. In one thousand consecutive gastro-intestinal cases in the study of which the barium enema was included, mucous colitis has been diagnosed only eight times. All of these cases gave pronounced clinical evidence of the disease. Just how many of the 92 per cent that were negative roentgenographically gave evidence of the disease clinically is not known, since a check of this kind in private practice is extremely difficult. The clinical diagnosis would have to be proven by demonstration of mucous casts in the feces.

The colonic changes are apparently shown best at the six-, nine-, or twenty-four-hour examinations after a barium meal. The barium enema may cause an unusual amount of discomfort to the patient, but in this condition it is probably of little diagnostic value, since nothing definitely abnormal is found. A good many authors believe that the colon just after an evacuation of the bowels has practically the same appearance as in mucous colitis.

Patients have consistently been questioned in regard to a bowel movement a short time prior to the examination, have come to the office just after an evacuation

Fig. 5. Same case as shown in Figures 3 and 4. Twenty-four-hour film, showing practically a normal colon.

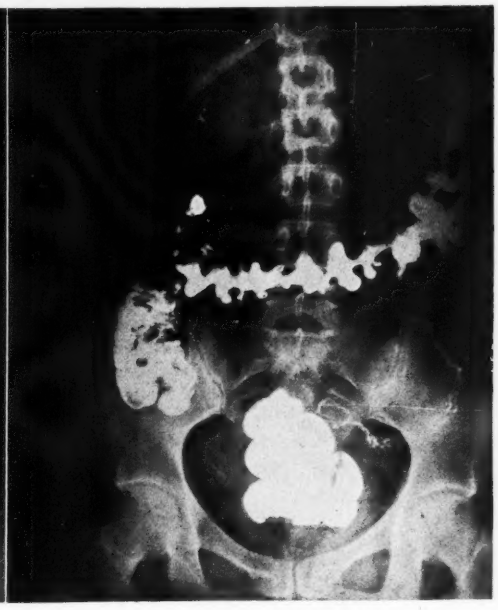

Fig. 6, Case 3. Patient is woman, 35 years old. Normal colon after barium enema and stool.

and have purposely been sent to the lavatory after a barium enema; and not in a single instance has re-examination shown the typical findings of mucous colitis. The appearance of the colon may simulate rugæ in the stomach except that the longitudinal lines of barium are all of finer texture, and frequently broken by haustral segmentation, but this appearance in no way simulates the typical string sign as first fully described by Crane.

Any part, especially the left side, but even the entire colon in severe instances, may show as a dense white line which may or may not be broken in places. This line must in part be due to marked spasticity of the colon, and in part to the barium held by the mucous cast of the bowel. The barium shadow usually varies from about one to four mm. in diameter. When and where the string sign really shows as a string it is, I believe, pathognomonic of mucous colitis. In thin patients the colon, especially when the left half is involved, can almost always be palpated as a rope-like structure. In two patients who were re-examined several months later the string sign was still present but involved less of the bowel. There was some improvement in the general condition of these patients. It is generally known that a certain amount of mucus in the colon is a normal physiologic condition and that this is increased in so-called simple or spastic colitis.

It is not in any way the purpose of this paper to exaggerate the importance of mucous colitis, but to attempt to get some idea of its frequency and the actual value of the roentgen ray in the diagnosis of the condition. The diagnosis of simple or spastic colitis is probably much more frequently made than the evidence justifies. The clinical diagnosis of mucous colitis in general practice is apparently rare, and if the number of surgical operations in such patients without relief of symptoms is any criterion,

Fig. 7, Case 4. Patient is woman, 32 years old. Shows a spastic colon after barium enema and stool, but typical string sign is not present.

Fig. 8, Case 5. Patient is woman, 50 years old. Shows spastic colon after barium enema and stool. The typical string sign is not shown.

a good many of these cases are being overlooked by both the clinician and the radiologist.

The abdominal cramps, tenderness, gas, nausea (at times), vomiting, etc., may closely simulate disease of the appendix or gall bladder and especially diseases causing pain in the left abdomen. All of the patients in the group reported had one or more abdominal operations without relief of symptoms, and a study of the operative findings leads one to believe that the operations were unnecessary, and would not have been performed had it been known that these individuals had mucous colitis.

In only four of the eight patients who were carefully studied roentgenographically was mucous colitis suspected clinically, until after the roentgen report; later the diagnoses were all confirmed clinically.

Crane has done a real service to radiology in calling our attention to the string sign in this condition.

CONCLUSIONS

1. Mucous colitis can probably be demonstrated roentgenographically in about 1 per cent of all gastro-intestinal cases.

2. The condition may, at times, simulate disease of the appendix or gall bladder, diverticulitis, splenic disease, etc., and not infrequently operations are done when the real trouble is this peculiar neurosis or allergic phenomenon.

3. The string sign, first fully described by Crane, is probably pathognomonic of mucous colitis. The absence of this sign does not, however, exclude the condition.

4. The appearance of the colon after a bowel movement following a barium meal

or enema does not apparently closely simulate this disease.

5. The radiologist is probably justified in making a diagnosis of mucous colitis when a typical string sign is present, whether or not he can obtain a history of the passage of mucous casts.

We must, however, be careful not to overlook other serious pathology in the abdomen when this form of colitis is found.

Quantitative Measurements in the Visible and Ultra-violet Absorption Spectrum of the Blood and its Components. Rud. Suhrmann, Werner Kollath, and Bruno Leichtentritt. Strahlentherapie, 1929, XXXII, 389.

In previous publications (*Strahlentherapie*, 1928, XXVII, 572, and XXX, 145), the authors presented the results of their studies of the absorption spectrum of the blood. This time, they investigated the absorption in the visible and ultra-violet region down to 2,340 Å. for plasma and blood corpuscles of rats suffering from xerophthalmia and rickets. In xerophthalmia, the absorption curve of the plasma varies considerably in the ultra-violet region from that of normal animals. This seems to be due to chemical changes in the plasma. The blood corpuscles did not show any appreciable difference. In rickets, the concentration of the absorbing components of the plasma is different from that of the normal animal. The composition is, however, approximately the same. The absorption of the red blood corpuscles is decreased at the border of the visible spectrum and increased in the short ultra-violet region.

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THE PRESENT STATUS OF ROENTGEN-RAY THERAPY IN BREAST MALIGNANCY[1]

By ALBERT SOILAND, M.D., Los Angeles, California

IT is apparent that the X-ray, in its present state of development, cannot reach much farther in the direction of curative value for malignancy. Whatever improvement in results have accrued during the past ten years, cannot be attributed to any improvement in either X-ray apparatus or equipment, but, rather, to improved technic, combined with a better physical and biological knowledge pertaining to the factors involved.

We wish to make it apparent that only regional massive malignancy, with or without metastasis, is under consideration in this discussion.

A number of leading surgeons feel that the X-rays have added nothing of value, either in a curative or inhibitory sense, to the surgical treatment of certain cancerous conditions, such as of the breast and uterus. Others again have no hesitancy in affirming their belief in the value of the X-ray as an adjuvant to surgery. We have to recall, of course, the stubborn fact that surgery has been the strongest arm of medical science since its inception, and has reached a stage of mechanical perfection which is a marvel in scientific accuracy. On the other hand, the X-ray is still in a comparatively experimental stage, having been discovered just thirty-four years ago. However, most radiologists will admit that the curative results obtained by the X-ray have fallen far short of expectations, particularly so in the high voltage short wave field, from which so much was expected by many of us at the initial exploitation of this energy a few years ago. There is comfort in the thought, nevertheless, that the whole science of radiology is as yet in the immature class: we may still have hopes for better results in the future.

In the meantime, what are the facts which can be deduced from an observation of post-operative radiation by means of the X-ray, such as has been more or less universally employed in the intellectual medical centers of the world? It seems that we have now accumulated sufficient data to evaluate the results of this work. There can be no question among those who have investigated impartially but that the method has been of tremendous value in diminishing pain, in destroying certain metastatic invasion, and in prolonging life; but the actual clinical cures, in the face of extensive metastasis, are pitifully few in number. This method has been thoroughly tried out, perhaps not with as much co-operation from surgical science as might be desired, but it is sufficiently comprehensive to warrant attention and to justify one in placing credence upon its evaluation.

On the other hand, pre-operative radiation with X-rays has not as yet been accorded the same amount of study. In some advanced clinics, careful observations with a limited number of patients have not shown sufficient encouragement to warrant the continuation of the work. In others of the same type, however, the operators feel that the method is worth further efforts and study. The writer has always believed that pre-operative radiation has distinctive values, especially if employed along the present lines of knowledge of radiation technic. We have attempted to put forth this thought to those surgeons with whom we are in daily contact, but as yet we have not had as much encouragement as could be desired.

The attitude of many members of the medical profession towards cancer treat-

[1]Read before the Radiological Society of North America at the Fourteenth Annual Meeting, at Chicago, Dec. 3-7, 1928.

ment is well exemplified by the following terse comments from an editorial in the *Journal of the American Medical Association*, October 27, 1928, page 1292:

"Surgical procedures do not invariably prove successful in eliminating malignant growths," and "The use of radium and the roentgen rays has been successful as a palliative under certain conditions."

From the first sentence it is evident that the editorial concedes clinical cures to surgery in a majority of cancer conditions, if we interpret the use of the word "invariably" correctly. The second quotation does not accord to radiation anything but the statement that it is "palliative under certain conditions." This attitude can mean only one of two things, either a strong conviction that surgery alone has a place in cancer therapy, or else a lamentable lack of knowledge of the accomplishments of radiation therapy in cancer during the past two decades. To the radiologist who has conscientiously and laboriously developed his method to its present high efficiency, this apparent antagonism from within our own profession is both detrimental and discouraging. How such an opinion can prevail in the face of the overwhelming preponderance of clinical evidence from the world's intellectual medical centers is beyond our comprehension.

If writers who really believe that radiation therapy is palliative only, and then only under certain conditions, could spend a few days in such clinics as those of Knox of London, Regaud of Paris, Sluys of Brussels, Holthusen of Hamburg, Holzknecht of Vienna, Reyn of Copenhagen, and Forssell of Stockholm, besides a great many others in our own and other countries, they would have an entirely different story to relate.

Some of us were fortunate enough to attend that epochal demonstration of the work at Radiumhemmet in Stockholm, where hundreds of patients were passed in review, showing clinical cures of more than five years' standing, of cancer cutis, cancer oris and lingua, cancer mammæ, cancer uteri, and so forth.

The editorial quoted cannot be viewed without resentment, but it appears that our only rebuttal is to carry on our altruistic work and to present it to the profession through our own journals, to the best of our ability.

To return to the title of this article, there are several reasons which make pre-operative radiation difficult to carry out, especially in cases where early surgical intervention is warranted. Another reason, but not so important, is the possible danger of delayed healing of the surgical wound or the potential effects upon the patient's general condition, thus prolonging surgical recovery. These objections, however, can be minimized to a marked degree, if not altogether overcome, by delaying the operation for approximately three to four weeks after the radiation course. We feel rather strongly that, in the great majority of cases, the patient would not have any bad effects from this surgical delay. Knowing that the X-ray actually destroys many visible post-operative recurrences, it is certainly reasonable to expect that the same rays in proper dosage can be equally valuable in inhibiting or destroying a pre-existing and an as yet unoperated-upon involvement. This should, by the same course of reasoning, more readily destroy or inhibit the very early invading malignant cells, some of which are, no doubt, not even suspected or their presence accounted for by any demonstrable method of examination, so that they naturally escape surgical removal.

In our own clinic, routine post-operative radiation treatment has been carried on carefully and persistently for the past two decades, and we feel that we are in a position to speak with some knowledge of this subject, because we know that a certain amount of benefit, which cannot be ignored, has followed this procedure. We are equal-

ly sure that we have not observed any instances in which such treatment has been demonstrated as a means of—or even suspected of—augmenting the disease or hastening its progress. This observation is quoted to combat the query frequently propounded as to whether radiation may not encourage metastatic hazards. There is no scientific basis that we know of for maintaining such a belief. Conversely, we know that radiation has lessened pain and distress, has retarded metastatic growth, and in innumerable cases has destroyed superficial recurrences. Even if the actual clinical cures are not many, the treatment has, at the very least, controlled many of the distressing external manifestations of cancer and prolonged life to no uncertain degree. In the comparatively smaller number of cases in which adequate pre-operative treatment can be carried out to a satisfactory conclusion, we are convinced that recurrences are the exception and not the rule. There are a small number of cases in which radiation has been applied directly to the wound before closing the operative field. These have all been successful in that no recurrences have taken place during the number of years over which these cases have been watched (1, 2). This type of work, however, presents such difficulties as to make a universal employment of the method impractical.

With the assistance of the surgical staff of the California Lutheran Hospital, in Los Angeles, we are now beginning to employ pre-operative radiation on a larger scale, and intend to keep as careful a record as is possible. We are aware that time must elapse and patience be exercised before definite results of this work can be tabulated, but we believe that the effort is warranted, and a careful check-up on all the factors will be available to those who care to follow the work through.

The writer addressed personal communications to a number of leading surgeons in order to learn their attitude regarding a study of pre-operative radiation, and he takes the liberty to quote here excerpts from their replies.

Dr. Emil G. Beck: "If you will have the opportunity to treat a large group of cases in which you have positive data to establish for the profession a standard and some rules by which this pre-operative treatment can be adhered to, you will render a great service to the profession as well as to the public."

Dr. Joseph C. Bloodgood: "In regard to your letter of April 18th, you are bringing up a very interesting and important question. I have already published the statement that I have not seen any improvement in the ultimate result of my cancer of the breast cases so far as cure is concerned—in the post-operative treatment."

Dr. George W. Crile: "I talked over your inquiry with our radiologists and they feel that an intensive investigation of the effects of pre-operative radiation should certainly be attempted and it would appear that it would be of benefit. We have little opportunity to test out such treatment here as such patients are usually referred to us for and desire immediate operation. You would have an opportunity such as we could not have for this investigation and we shall await with keen interest your findings."

Dr. Robert B. Greenough: "For the past two years we have been giving pre-operative radiation to another series of operable cases, but, of course, they are not yet ready to report."

Dr. E. S. Judd: "I am in receipt of your letter asking my opinion of the value of pre-operative and post-operative radiation in cases having malignancy. Personally I think that such a study as you outline will be a fine thing. There has always been a question in my mind as to just how much the various forms of treatment accomplish. I should like very much to know how much pre-operative and post-operative irradiation adds to the permanency of the cure in can-

cer cases, but I do not believe this has ever been carefully studied out."

Dr. Howard A. Kelly: "Such a line of experimentation as you suggest would be extremely valuable and I would urge you to go ahead with it; please let me know of any conclusions you may draw."

Dr. Douglas Quick: "If I were to stress one or the other as being of greater importance, I should say that in my judgment thorough pre-operative radiation is of more value than any post-operative treatment. I find that I am constantly increasing the intensity of my pre-operative radiation and allowing a corresponding time interval before carrying out the actual surgical procedure."

Dr. Bernard F. Schreiner: "My contention for the last five or six years has been that pre-operative radiation was desirable theoretically and practically. I have personally treated cases, especially breast cases, with complete pre-operative radiation, following the radiation in one, two, or four weeks, up to periods of six months after, with operation."

It will appear from the foregoing that such a study as we are now undertaking has valuable potentialities. In some advanced clinics the radio knife, or electric scalpel, is taking the place of the cold knife in resections of breast tumors. It seems that this type of surgery has advantages over the ordinary scalpel in that a certain amount of sterilization follows the path of the instrument, and there is less hemorrhage and consequently an appearance of less danger of knife implantation of degenerated cells. We believe that this type of surgery in breast malignancy has advantages to a patient, particularly as primary union takes place if the work is properly performed. This, however, must be left to those who are qualified to speak. The trend of the times seems to lead to this method, in conjunction with pre-operative radiation, as a step in advance in our fight against cancer.

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THE FIVE-YEAR END-RESULTS IN CARCINOMA OF THE BREAST[1]

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TWO hundred fifty carcinomas of the breast were treated in the clinic up to the end of the year 1923. Two of these occurred in males. One hundred seven of the cases were primary and one hundred forty-three recurrent tumors. The diagnoses were corroborated by microscopic examination. The treatment, which consisted of a combination of surgery and radiations, was preceded by a routine X-ray examination of the chest organs and the skeleton, as such extension of the carcinoma may be found though the primary breast growth may be small. Operability was determined from the clinical extent of the growth, while fixation of the tumor mass in any one of its regions usually meant an advanced and hopeless carcinoma which should not be treated with the expectation of attaining a good end-result.

The indicated method of treatment was, therefore, determined by a clinical examination. To facilitate this procedure an outline for history-taking and a clinical grouping has been evolved which is presented in Tables I and II. They show the routine questions that must be inserted in the history, the important factors observed in the clinical examination, and the clinical grouping based on the physical signs.

The breast cancers were divided into primary (indicated by the capital letter *P*) and recurrent (indicated by the capital letter *R*). A freely movable, solitary growth with no other evidence of tumor invasion or metastasis places the case in Group P 1. A cancer begins as a solitary focus—a nodule.

TABLE I

RECORD FOR CARCINOMA OF BREAST

Site of tumor: Age:
Name of patient: Married:
Address: Parity:
Location of tumor: No. lactations:
(Right) (Left)
History of infection of breast:
History of trauma of breast:
X-ray findings: *(a)*. Chest wall
(b). Lungs
(c). Skeleton
Date of operation:
Description of operation:
Findings on operation:
Histologic diagnosis:
When did recurrence begin, and how?

It is localized and hence a beginning malignant growth. Multiplication of the tumor and involvement of the inferior axillary lymph nodes, with normal mobility and elasticity of the tumor area, indicate an active spread of the growth and such cases are assigned to Group P 2.

Invasion of the superior axillary lymph nodes, or the skin (indicated by pitting), or the anterior fascia of the pectoralis muscles (indicated by adhesion of the breast to the muscles) puts the case into Group P 3. Such clinical findings are indicated by an *"X"* on the chart in the proper column. Rigid fixation of the breast tumor to the chest wall, or invasion of the entire thickness of skin, with tumor formation or ulceration, or rigid fixation of the axillary lymph node masses to the tissues of the axilla, or invasion of the supraclavicular lymph nodes occur in advanced cancers and are placed in Group P 4.

Fixation of the growth to the pectoralis muscles is present when the breast cannot be moved over the muscle, as the latter is put on tension by abduction and raising of

[1]Read before the Radiological Society of North America at the Fourteenth Annual Meeting, at Chicago, Dec. 3–7, 1928.

TABLE II

CHARTING OF CLINICAL FINDINGS IN PRIMARY CARCINOMAS

Group	Tumor clearly limited	Multiple tumors	Inferior axillary glands involved	Superior axillary glands involved	Skin adhesions	Pectoralis muscle adhesions	Rigid fixation of tumor mass	Supra-clavicular glands invaded
P 1								
P 2								
P 3								
P 4				2	3	4		

CHARTING OF CLINICAL FINDINGS IN RECURRENT CARCINOMAS

Group	Local recurrence but movable	Regional recurrence but movable	Local and regional recurrence, both movable	Fixation of regional glandular recurrence	Fixation of local recurrence to skin	Fixation of local recurrence to chest wall	Supra-infra-clavicular glandular recurrence
R 1							
R 2							
R 3							
R 4				2	3	5	

An X sign in a space indicates the clinical findings and hence the clinical group.
The clinical findings should be corroborated by macroscopic and microscopic examination of the removed breast tumor. If operation is contra-indicated, then a biopsy should be performed.
2XXX indicates a rigid fixation in the axillary space.
3XX indicates an invasion of the entire corium. XXX indicates an invasion of the entire corium, with ulceration.
4XXX indicates rigid fixation to pectoralis muscle.
5XXX indicates a rigid fixation to the chest wall.

the arm over the head. Rigid fixation of the pectoralis muscle to the chest wall is determined by rigidity and immobility of the muscle when the arm is in a hanging, relaxed position. Fixation of the tumor to the chest wall denotes invasion of the soft and osseous structures, especially the periosteum and perichondrium of the ribs. (See Table II.)

The recurrent breast cancers were also divided into clinical groups. A solitary local freely movable node recurrence is placed in Group R 1. A movable regional lymph node recurrence is assigned to Group R 2. If movable local nodes and movable regional lymph node recurrences are present at the same time, then the case is put in Group R 3. Recurrences with rigid fixation of the recurrent nodes in the axilla, the chest wall, or the skin, or supraclavicular lymph node extension are allotted to Group R 4. (See Table II.)

The grouping and the method of treatment for each group are given in Tables III and IV. It is not deemed necessary to give the factors of the radiation technic as this has been described previously.[2]

The five-year good end-results of the primary carcinomas are shown in Table V for each year and for each clinical group. There were 29 good end-results among 107 cases, or 27.10 per cent. In 332 cases of primary cervical carcinoma treated during the same period of years with radiations there were 58 five-year good end-results, or 17.50 per cent.

The radical panhysterectomy for cervical carcinoma has been displaced in our clinic by massive radiation therapy. The high operative mortality of surgery, the safety of

2Schmitz, Henry: The end-results of the Treatment of Carcinoma of the Breast with Surgery, Radium, and Roentgen Rays. Am. Jour. Roentgenol. and Rad. Ther., 1924, XII, 531-536.

TABLE III

GROUPING OF PRIMARY BREAST CANCERS, WITH INDICATIONS FOR TREATMENT

	Clinical Findings	Indicated Treatment
Group P 1	Single, limited, freely movable growth.	Surgery.
Group P 2	Multiple, limited, freely movable growths, with or without inferior axillary lymph node involvement.	Surgery followed by radiation.
Group P 3	Movable tumor in breast, with superior axillary gland invasion, or skin adhesions or pectoralis muscle adhesions.	Radiation followed by surgery.
Group P 4	Rigid fixation to pectoralis muscle or to axillary structures or ulceration of skin or supraclavicular glandular involvement.	Palliative treatment and radiation to check growth, relieve pain.

TABLE IV

GROUPING OF RECURRENT BREAST CANCERS, WITH INDICATIONS FOR TREATMENT

	Clinical Findings	Indicated Treatment
Group R 1	Local freely movable recurrence.	Ratiation followed by surgery.
Group R 2	Regional freely movable axillary lymph gland recurrence.	Radiation followed by surgery.
Group R 3	Local and regional but freely movable recurrence.	Ratiation followed by surgery.
Group R 4	Fixed local or regional recurrence or ulceration of skin or supraclavicular glandular involvement.	Palliative treatment and radiation to attempt to check growth or relieve pain.

radiation treatment, the high relative curability (among 71 operable cases it was 38, or 53.52 per cent), and the standardization of the technic of combined radium and X-ray therapy have been important factors in the decision to discard surgical treatment. On the other hand, radical amputations for mammary carcinoma are safe. The technic of radiation therapy of breast cancers is still an unsolved problem on account of the site of the tumor, the extent of the cancer-bearing area, and the chest organs, namely, lungs and heart, with their large volume of blood within the paths of the ray beams. The five-year relative curability percentage from surgery and subsequent radiation therapy of Groups P 1 and P 2, 42 cases with 23 five-year recoveries, was 54.76 per cent. One is reluctant, therefore, in replacing a satisfactory method of treatment with radiation therapy, the technic of which has not as yet been standardized so that it shows uniformly good results.

Perhaps in selected cases radium capsules filtered with 2 mm. silver and lead or gold-filtered radon seeds could be embedded in the center of the tumor through an artificial canal, as is done in cervical cancers. This would permit prolonged application of the radium without fear of destruction of the skin or chest wall. The neck, axilla, and breast could be subjected to treatment with radium packs at a focus skin distance of 10 cm., applying about 25,000 milligram element hours to an area 10 cm. in diameter, or X-ray applications to the same area with varying voltages, filters, and focus skin distances, depending on the varying conditions of the individual patients.

Table VI gives the five-year good end-re-

TABLE V

THE PRIMARY CARCINOMAS OF BREAST, WITH GOOD FIVE-YEAR END-RESULTS

	1914	1915	1916	1917	1918	1919	1920	1921	1922	1923	Total
Group P 1											
Number			2	2	1	2		1		5	13
5-year well			1	1	1	2		1		3	9
Per cent well											69.23
Inconclusive										2	2
Group P 2											
Number			3	1	6	2		3	6	8	29
5-year well			2	1	2	1		3	4	2	15
Per cent well											51.72
Inconclusive									2	3	5
Group P 3											
Number			3	1	3	7	1	4	4	11	34
5-year well			1	0	0	1	0	1	0	1	4
Per cent well											11.77
Inconclusive								1	3	5	9
Group P 4											
Number	2	2	3	1	1	3	1	2	8	8	31
5-year well	0	0	0	0	0	0	0	0		1	1
Per cent well											3.23
Inconclusive								1	3	3	7

Total number, 107. Total number well for 5 years, 29, or 27.10 per cent.

TABLE VI

THE RECURRENT CARCINOMAS OF BREAST, WITH GOOD FIVE-YEAR END-RESULTS

	1914	1915	1916	1917	1918	1919	1920	1921	1922	1923	Total
Group R 1											
Number	1		3	2	3	1	1	2	8	1	22
5-year well	0		2	1	3	0	1	1	2	0	10
Per cent well											45.91
Inconclusive								1	4	1	6
Group R 2											
Number	1	2	4	1	1	4	1		1		15
5-year well	0	2	1	0	0	1	1		0		5
Per cent well											33.33
Inconclusive											
Group R 3											
Number	2	1	7	3	10	4	4	3	5	6	45
5-year well	0	0	0	0	2	0	0	0	1	1	4
Per cent well											8.89
Inconclusive									2	3	5
Group R 4											
Number	2	4	6	5	2	4	3	9	15	11	61
5-year well	0	0	0	0	0	0	0	0	4	1	5
Per cent well											8.19
Inconclusive								3	4	4	11

Total number, 143. Total number well for 5 years, 24, or 16.85 per cent.

sults achieved in the treatment of recurrent breast cancers. The five-year end-results were about the same in Groups R 3 and R 4. The latter group of cases are characterized by rigid fixation of the recurrent nodules. Fixation of a carcinoma ordinarily means a hopeless stage of cancerous disease. The Group R 4 cases with five-year good end-results had local recurrences, with fixation of the nodules to the chest wall or corium. Ra-

diation, with wide cautery excision, brought about the favorable results. Glandular recurrences do not respond well to radiation therapy.

In general, it may be stated that the absolute five-year curability percentage of 27.10 is higher in breast cancers than that of 17.50 in cervical cancers. This fact may be explained by the high operability percentage in the former, namely, 39.25. The operability percentage in cervical cancers was 21.38. *Operability* in this case means limitation of the cancer to the organ of primary invasion.

Group 4 cases in primary breast cancers counted 31, or 29.06 per cent, and in cervical cancers 100, or 30.01 per cent. A lump in the breast can be felt and even seen by the patient. A uterine cancer is an internal cancer and hidden from sight and touch. The significance of a lump in the breast is or should be known to a large proportion of the public and its discovery should induce the victim to seek medical aid immediately. The hemorrhage of a cervical cancer alarms the patient and is often the first symptom. The disease usually has already advanced greatly, as hemorrhage results from the breaking down and ulceration of tissue. These are associated with advanced stages of the tumor growth, and the prognosis is correspondingly poor. Are the efforts of enlightenment of the public concerning malignant growths of the breast really crowned with success? Or is professional laxity or optimism to be blamed for this appalling state of affairs?

The five-year good end-results of each clinical group obtained in this series of cases have not been compared with other statistics, as the latter have not been divided in clinical groups according to our procedure.

The rules of treatment observed in this series of cases are:

1. The treatment of localized malignant tumors of the breast, assigned to Group P 1, should be surgical.

2. Radiation therapy should follow the operation after perfect healing has occurred if the inferior axillary lymph nodes are found to be carcinomatous. Such cases are assigned to Group P 2.

3. Radiation therapy should be used if the superior axillary lymph nodes are invaded, if the breast is adherent to the pectoralis fascia, or if the breast has become attached to the skin. Such cases are put in Group P 3. Should the lymph nodes remain stationary in growth, or the breast become movable, and the skin assume macroscopically a normal condition eight to ten weeks after radiation, then radical amputation may be advisable.

4. Rigid fixation of primary breast cancers to the chest wall, or to the axillary structures, or invasion of all the skin layers or the supraclavicular lymph nodes indicates radiation therapy. The latter is the best palliative treatment in our possession. Surgery does not offer any improvement or palliation.

5. The recurrences of mammary cancers should always be treated with radiation and followed by surgical eradication, preferably with the cautery knife, within from eight to ten weeks if the recurrent nodules are freely movable. Local recurrences respond to radiation better than glandular metastases.

Radiated tissue shows a tendency to heal slowly and becomes easily infected after early operation. A long siege of convalescence is the usual observation if operation is performed soon after radiation treatment. In our earlier reported cases we advocated operation within a short time after radiation, but the many complications from such a procedure compelled us to change our method.

CONCLUSIONS

1. A method has been outlined whereby the clinical grouping of breast cancers may be determined: such grouping is considered

an absolute necessity in the prognosis and treatment. The results of treatment show that a carcinoma characterized by fixation, whether it is primary or recurrent, offers a bad prognosis for any method of treatment.

2. The five-year good end-results in 107 cases of primary breast cancers were 27.10 per cent and in 143 recurrent cancers 16.85 per cent. The total five-year salvage in 250 cases was 53 cases, or 21.21 per cent.

3. The rules of treatment, based on the clinical groups, have been given. Attention is drawn to the fact that radiation after operation should not be given until complete healing from the operation has occurred. An operation after a preceding radiation treatment should not be performed until from eight to ten weeks after such treatment. The tumor should show regression, *i.e.*, have been really converted into a freely movable and limited carcinoma. The tissues of the chest wall will recover from the effects of the radiations within this time and surgical eradication now will be followed by union of first intention.

DISCUSSION

DR. U. V. PORTMANN (Cleveland): I am delighted to congratulate the members[1] who have taken part in this symposium, on having presented a great many interesting phases of this vast problem of breast carcinoma. There are one or two things I should like to speak about. I think that since few of us have had the opportunity of treating as many cases pre-operatively as has Dr. Soiland, we must take his opinion—not only radiologists but surgeons as well—as to the "worth-whileness" of pre-operative radiation. I think that we have yet some things to prove, and the investigations of Dr. Soiland will be received with a great deal of interest. Theoretically, of course, pre-operative radiation should be of great assistance. I believe that we may have to change our views as to whether or not we block off lymphatics by radiation, since the experiments of our friend, Dr. Wood, may have proved that the lymphatics are not actually blocked off by the direct effect of radiation. By pre-operative radiation, however, we always destroy a certain number of malignant cells and perhaps render others quiescent which at operation might have been transplanted, forming emboli by dissemination. Also, it is possible that we do block off lymphatics when they are involved by neoplastic processes. Good surgeons always attempt to clean out an axilla in a case of breast cancer, and more than 95 per cent of patients have axillary involvement when they come to the surgeon. Now it seems to me to be somewhat futile to attempt to clean out an axilla by any surgical process or to remove all of the malignant growth which is present. Our statistics bear out this point. When the axilla is involved, as it is in 95 per cent of cases, supraclavicular involvement is already present in a very large majority, and when the supraclavicular nodes are involved, of course surgery is usually futile.

When we consider that the natural duration of life of a patient with breast cancer is about three years, it would seem that surgery alone has not offered the patient a great deal, as far as actual cure is concerned. Usually the local tumor is easy to deal with; there is no difficulty about that; it may be removed by any one of many methods, but the crux of the matter is to remove sufficient skin and to go far enough with the dissection. Whether this is done by cautery or a sharp knife makes, I think, little difference. I have never seen a local recurrence in a case in which a wide dissection of the skin has been made and the deep muscles removed. It probably may occur from intercostal transplantation, but I personally have never seen this sort of local recurrence. On the other hand, I have seen—we all have—metastases, either in the lungs or bone, which

[1]The third paper in this symposium, "Radiotherapy and Electrosurgical Practice Combined in the Treatment of Malignancy," by Dr. B. H. Orndoff, will be published in a later issue.

indicate that the condition is not a localized disease. I have had no experience with the electrocautery, but it seems to me that, putting aside the question of irritation from instruments, ligature, and sutures, there is only so much tissue that can be removed, whether with a sharp knife or electrocautery, and if the surgeon removes the tissue to that limit, he has gone as far as is possible in the surgical treatment of this disease.

The statistics that Dr. Schmitz reported are certainly very interesting, and he is to be congratulated upon the success he has attained with these cases. We have to analyze cases and make statistical reports in order to inform ourselves as to what results we are getting from various types of treatment. If radiologists have done no other thing than to call the attention of surgeons to their own shortcomings and to the possibilities of other methods of treatment, we have accomplished a great deal. However, in evaluating statistics, we must first take into consideration the natural duration of the life of the patient with breast cancer, which is about three years; indeed, we see cases in which cancer of the breast has been present for a great many years. I have seen one case in which a cancer was present for twenty-seven years and the patient lived without treatment. We must, therefore, be very careful about drawing conclusions. Another thing, I would urge the classification of cases either on the plan which Dr. Schmitz has presented, or on the basis of Steinthal's classification.

The final solution of the problem is, of course, not in surgery or radiation or electrocautery or any one procedure. There must be a combination of all these things and the proper combination must be applied to the particular case at hand. We must always consider the fact that cancer of the breast is not a localized lesion, but a disease of the patient, and we must treat the patient as well as the localized lesion, which, after all, is taken care of easily.

Dr. M. J. Sittenfield (New York): It seems to me that there is very little to add to what has been said about the general status of cancer—the same applies to cancer of the breast as well. After all, the degree of malignancy of the tumor and its radiosensitivity are the really important factors in the prognosis of cancer of the breast. Hearing Dr. Portmann and other speakers state that practically 95 per cent of the cases of carcinoma of the breast operated upon already have axillary involvement or nodes in the supraclavicular region, indicating a more or less general spread of the disease, I would like to ask, What is a really favorable setting for the surgeon in a case of cancer of the breast? If the 95 per cent of so-called operable tumors already have metastases manifested in the regional glands, I would like to know how many of them already have spread intrathoracically, or elsewhere in the body. Now then, if this condition exists, of how much value will the mechanical removal of the tumor be? On the other hand, if there is no other procedure in this condition except mechanical excision of the tumor, I cannot see any objection to a pre-operative radiation. It surely is not going to disperse more cancer cells into the field of operation; if anything, it is going to sterilize some of them. The only slight objection that may be brought up is the one I have heard Dr. Wood very properly express —that the tumor itself may diminish in size after the pre-operative radiation to such an extent that the patient either may delay or refuse operation. Aside from this, I do not see any objection to submitting a patient to pre-operative radiation, since 95 per cent of cases have dissemination of the tumor. I believe it is Perthes and two or three others who claim to have obtained unfavorable results after post-operative radiation. They seem to feel that their patients did not live as long after radiation as they would have lived without post-operative radiation. Dr. Schmitz has mentioned that about 18 to 20

per cent of the cases of the operable type of cancer of the breast survive the five-year period. Surely not an enviable record, when we know from statistics published a few years ago from the Middlesex Hospital in London that in a series of patients on whom no treatment had been instituted, the mean average of life in cancer of the breast was about three years and two months. That means that some of them lived six months, and others twenty-one years. This makes it questionable whether surgery alone or surgery with radiation shows a much better result. There is simply one point wherein I differ from Dr. Schmitz, namely, it has been my misfortune, perhaps, to see recurrent nodules in the breast which have been operated upon the second time, and in no case have I seen a satisfactory result.

Dr. E. G. Beck (Chicago): I cannot share the pessimism expressed by the previous speakers. We have not nearly exhausted our resources in the treatment of cancer of the breast; we have barely begun, and I feel the time is not far distant when recurrence will be the exception rather than the rule.

If I were asked to mention the principal cause for our apparent failures, I would unhesitatingly say that it is the lack of co-operation between radiologists and surgeons. When a surgeon is confronted with a case of carcinoma he naturally thinks of the removal of the growth first and the radiologist thinks of the radiotherapy first. The proper co-operation between the two would bring the best results. We must remember that every cancer cell which is retained in the field after operation is a potentially recurrent cancer. It is, therefore, essential that every cancer cell be destroyed if the patient is to have a permanent result. When a patient leaves the hospital with a good clean wound, with a primary union, only two weeks or so after the operation, she is happy to have recovered so well and is filled with hope that from now on she will be well, but what a shock to her when, a few months later, she is told that the growth is recurring.

The reason for this frequency of recurrence is, in my opinion, incomplete post-operative radiotherapy. I do not mean by this that the roentgenologist does not apply radium or X-ray scientifically, but that he is unable to deliver a sufficient dosage into the depth of the closed wound to kill every cancer cell which has been retained, because the dosage required would be harmful to the skin and the overlying tissues. This obstacle can be overcome by the surgeon. If he would leave the wound open so that sufficient radiation might be delivered into the depth without danger to the patient, it would be possible to destroy the carcinoma cells before the wound closes.

The secondary closure by regeneration of the skin over the open wound takes longer, it is true, but recurrence of the cancer is of the first importance and the closure of the wound of secondary importance.

It has been my experience that the first operation must be a success, because, if recurrence takes place, the patient usually becomes incurable.

Whether the pre-operative treatment is advisable is a mooted question. I have rarely employed it because I believe that we should not delay the operation too long; a delay of two or three weeks may allow the growth to progress to the stage where it may not be operable.

In 1924 I brought before this Society a number of patients and a paper dealing with this open method of surgery for carcinoma. Now, five years later, I am convinced that this method prevents recurrence in a very large number of cases. I shall be able to show some of these cases again to-morrow at the clinic. The skin which covers these denuded surfaces appears to be normal; it is movable but it does not contain hair or sweat glands. The technic varies in different cases. It is described in my previous publications.

There are other disadvantages in this open method but they are of minor importance when we look for end-results. Infection of the open wound is not an objection; it is rather an advantage; in no case in my series was it of any consequence. The patient, of course, is confined to the hospital for a longer period and the wound has to be dressed every day for two or three months, which, among the poorer classes, is also a drawback, but none of these objections have deterred me from applying this open method for cancer therapy.

DR. ELLIS FISCHEL (St. Louis): When Dr. Ernst asked me to participate in the discussion at this symposium on cancer of the breast, I felt sure that he desired the discussion from the surgical point of view. It is always interesting for a specialist in one field to listen to the discussion of a subject in which he is very much interested from the point of view of specialists in another field. Therefore, I was particularly entertained by the radiological participants in this symposium who were so free in their criticism of my brethren in their treatment or lack of treatment of their patients suffering from cancer of the breast.

In my conception of this disease, as applied to the breast, I can see no logical reason for combining surgical therapy and radiation therapy in operable cases. Cancer of the breast is a superficial disease when in the curable stage. The radical operation, when properly performed, is one of the few ideal operations for cancer located anywhere in the body. Such an ideal operation includes the wide removal of the primary focus of the disease with all the tributary lymphatic channels and glands. If such an operation is properly performed in cancer of the breast, the disease is theoretically completely eradicated, and there is no chance for recurrence, either local or in the immediate draining lymphatics.

As I can see the plan of pre-operative or post-operative radiation in the treatment of cancer of the breast, the logic of such treatment is based upon the fact that radiation will either kill or inhibit the growth of cancer cells within the field of the proposed operation, and hence will prevent local recurrence or the wide dissemination of cancer which is occasionally supposed to take place following surgical interference. As I stated before, cancer of the breast is a superficial disease. Now, it seems to me that if radiation will kill or inhibit the growth of cancer cells before or after surgical interference, it should do the same thing without surgery. Therefore, it is just as logical to omit the surgery altogether and rely entirely upon radiation for the cure of the patient as to use both surgery and radiation.

In regard to the question of metastasis beyond the field of operation, I have this point of view: the most obvious and common site of such metastasis is the lymph glands in the supraclavicular region. These are not ordinarily included in the usual radical operation for cancer of the breast. These glands bear the same relationship to cancer of the breast that they do to metastasis from cancer of the lip, face, or mouth. They are relatively superficial in location, and there is nothing about their structure or anatomical location in reference to vital organs which prohibits effective radiation. Yet, in a large experience of metastatic cancer located in these cervical and supraclavicular lymph nodes which have been radiated by competent radiologists, I have yet to observe a case in which life has been prolonged by the use of radiation when metastases were once proven to be located in these glands. If radiation cannot be used effectively to eradicate the disease from these comparatively superficial metastatic lymph nodes, how can it be expected to arrest the disease in deeply situated lymphatic glands or in vital organs such as the lung or liver?

I have heard the statement made this morning that the surgeon does not give the

radiologist a fair show. The surgeon, I think rightly, considers cancer a surgical disease by proving that he can effectually eradicate cancer from the body. He won this disease from the internist; he won it from the quack, because he was able to demonstrate that he could get better results. The surgeon cannot be fairly criticized for being obstinate in his hold upon the treatment of carcinoma because he has yielded in the question of carcinoma of the cervix, since the radiologists have shown that through radiation just as good, if not better, results can be obtained. If the radiologist can demonstrate just as good results through radiation alone in the treatment of cancer of the breast, I am sure you will find the surgeon most co-operative and most willing to yield this disease to his care.

Dr. F. C. Wood (New York): In the first place, as regards radiology and the metastatic distribution of tumors, as is alleged by surgeons, there is this to be considered: that by raying tumors every one will acknowledge the growth may be slowed down and held quiet for a number of years. During that period, unusual and extraordinary metastases often occur which have not been observed clinically previous to radiation. In regard to post-operative radiation, statements have been made that post-operative radiation does not prolong the life of the patients observed. I do not at all agree with that; I think that almost every man in this room has had individual cases in which life has been prolonged, unquestionably, and even permanent cures. I have had a number of them myself. The number is small, it is true, but we must not forget, in using statistics, the individual himself, and there are a certain number of individuals everywhere who are extremely grateful to radiologists for keeping them in health long after a local recurrence, which would have inevitably caused death within a year or so. I think that is the foundation for post-operative radiation, not statistical studies, because I believe that post-operative radiation does not save many lives. Breast tumors—some of them, at least—are peculiarly sensitive to radiation, and this is a field in which every case should be radiated post-operatively. Many will fail to gain much from such radiation, but there will be occasional patients—and I estimate the number as between 5 and 10 per cent—whose lives will be prolonged over a long period. In my records there are seven patients who had local recurrences on the sternum, on the ribs, or in the supraclavicular nodes, who are still alive and well five years after with no evidence of newgrowth. Whether they will stay perfectly well, I do not know. Many surgeons have changed their attitude in the last six years and are referring to me a large proportion of their cases for post-operative radiation, solely on the demonstration of what has been done in my own clinic, and when you can convince a surgeon that radiation therapy is of benefit, you have done a good deal.

Dr. Soiland (closing): About seven years ago, at the Surgical Section of the American Medical Association in Boston, a New York surgeon made the statement that he had not seen a single case of carcinoma of the cervix cured by radium and never expected to see one. A number of men in this room were there at that meeting and will remember the incident. I do not believe there is a single radiologist in this room who has not seen at least one five-year cure, or at least a five-year recession of symptoms in secondary malignancy, with the possible exception of Dr. Fischel.

Dr. Schmitz (closing): One could take quite a long period of time to answer all the statements, objections, etc., that have been raised after these three papers, yet personally I feel that I am an optimist. I always have been one, and when I am called to a patient, I like to do for that patient whatever I can, and probably this has been the

reason why I have been getting after these carcinoma patients and trying to do for them what it was possible for us to do. I am quite sure that that has been the factor which created in me the interest in this work.

Now then, if we wish to disprove the statement that radiations are of no benefit in surgically treated cases of carcinoma of the breast, we can immediately do this by the results of radiation therapy in the recurrent carcinomas of the breast. All the recurring carcinomas put on the screen during this symposium occurred after surgical operations without radiation; if it was possible in those, the surely hopeless cases, to obtain, in a hundred and forty cases, 17 per cent or more of five-year good end-results, then I think the efforts of the radiologist should be recognized and that no patient with recurrence of carcinoma of the breast should be left without this valuable method of treatment.

Finally, it seems to me that there is a lack of co-operation and understanding between the surgeon and the radiologist. I believe the radiologist is wrong who treats every case that comes to him with radiation; I feel that the case should be first clinically examined and studied carefully, and then it should be determined what is to be done for that patient. If it is a surgical case, let the surgeon treat it; if the surgeon says it is not a surgical case, let the radiation therapist treat it. The great difficulty has been the lack of co-operation. I am reminded of the wonderful years it was my privilege to spend with the late Albert Ochsner, who certainly had his share of carcinomas to treat, and after a few years' association, he left every case of carcinoma that came to him to me. If I declared the case to be operative, it was operated on; if I thought the case should be first operated on and then radiated, that was done; if I thought it should be first radiated and then operated on, that was done. Out of this co-operation between Dr. Ochsner and myself, he arrived at some conclusions. I remember the statement he made at the meeting of the American Medical Association in Boston, in 1923 or 1924, when he said that, in 1917, I had proven to him that radiation therapy in carcinoma of the cervix gave the patient a better chance than either surgery (that is the knife) or the cautery, and therefore he did not operate on these cases any more. I am certain that if he had lived a few years longer, other regions of the body would have come under the same method of treatment.

All in all, we should begin to realize that we ought to give our patient the best chance, and if it is possible for us to prolong the life of a patient only two or three years, during which time he may enjoy subjectively perfect health, we are doing something which no surgeon ever could have done. This reminds me of an instance of a widow who said to me, after I had examined her and told her that she had an inoperable carcinoma: "It is the greatest shock in the world; it is not my life I am worried about, but I have a son fourteen years old—I am working day and night to earn the money to give him an education and let him go through high school; after that I feel that he will be able to take care of himself. If I only could live three years!" I radiated this woman's cancer and she lived four years and saw her son graduate with honor from the high school. After that I took care of him and saw that he began his medical studies and carried them through. Such instances—economic instances—you will find by the thousand, and I am quite certain that every surgeon will agree with us that if he can by radiation extend to a person suffering from cancer such a possibility of two or three years' life, he ought to do so, and he will agree with us that there is value in radiation.

THE INFLUENCE OF PHENOLPHTHALEIN ON INTESTINAL MOVEMENTS[1]

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THE time allotted to this paper will not permit of a detailed discussion of the history of phenolphthalein as a chemical reagent nor as a medicinal drug after the accidental discovery of its laxative properties. We know that it was introduced into therapeutics early in the present century and that it has come to be very largely used, perhaps the most largely used laxative drug in the pharmacopeia. As such, its importance justifies close inquiry into its pharmacological action and a careful appraisal of its therapeutic value. It would be interesting as well as of great scientific importance to learn just how this drug, or, for that matter, any drug, produces an increased motor activity of the bowel.

As a preliminary to a consideration of this subject, it may be well to review briefly the prevalent ideas on the physiological action of laxatives. Some drugs of this class have been known and used for many hundreds of years, and it stands to reason that frequent attempts have been made to explain their action. Perhaps no more authoritative statement can be found than that made by Dr. A. R. Cushny in the eighth edition of his well-known work on Pharmacology, which appeared in 1924. In his discussion of purgatives in general, he said:

"The ideal purgative is devoid of any effects whatsoever, save in the intestine; it passes through the stomach without materially deranging its function, and is not absorbed, or at any rate has no sig-

[1]Read before the Radiological Society of North America at the Fourteenth Annual Meeting, at Chicago, Dec. 3–7, 1928.

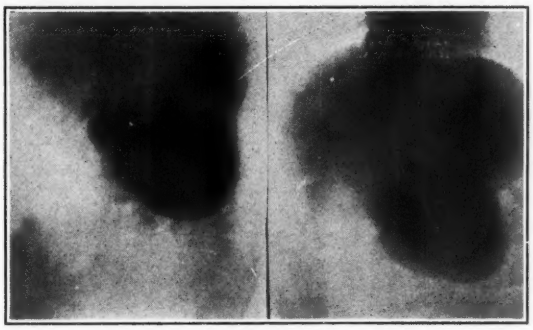

Fig. 1-*A*, Series I (*left*). One hour twenty minutes after barium breakfast.
Fig. 1-*A*, Series II (*right*). One hour after barium breakfast and 1 grain phenolphthalein.

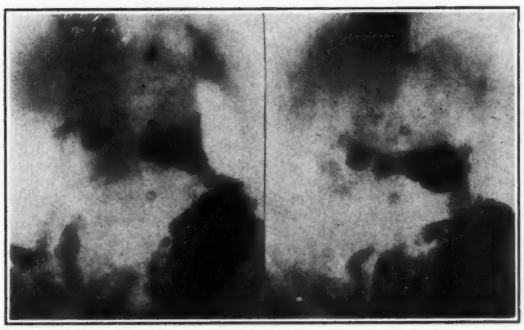

Fig. 2-*A*, Series I (*left*). Five hours after barium breakfast.
Fig. 2-*A*, Series II (*right*). Five hours (less ten minutes) after barium breakfast and 1 grain phenolphthalein.

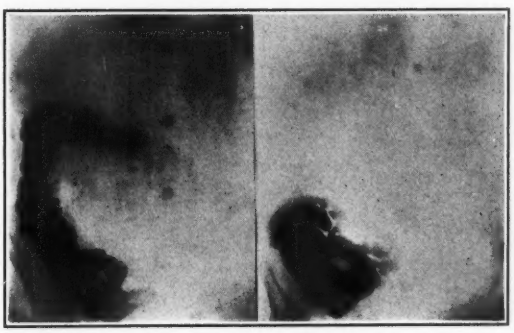

Fig. 3-*A*, Series I (*left*). Ten hours after barium breakfast.
Fig. 3-*A*, Series II (*right*). Ten hours five minutes after barium breakfast and 1 grain phenolphthalein.

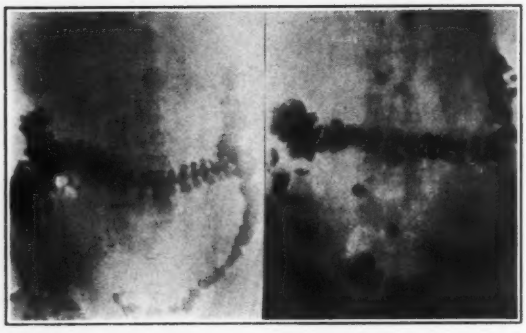

Fig. 4-*A*, Series I (*left*). Twenty-eight hours fifty minutes after barium breakfast.
Fig. 4-*A*, Series II (*right*). Twenty-eight and one-half hours after barium breakfast and 1 grain phenolphthalein.

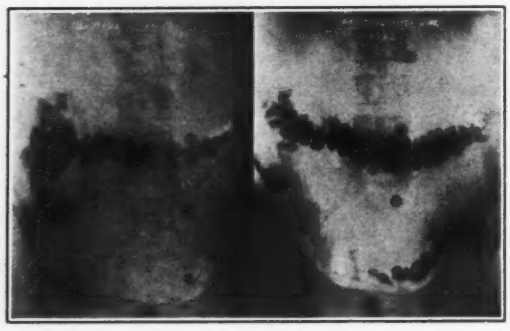

Fig. 5-*A*, Series I (*left*). Thirty-three hours forty minutes after barium breakfast.
Fig. 5-*A*, Series II (*right*). Thirty-four and one-half hours after barium breakfast and 1 grain phenolphthalein.

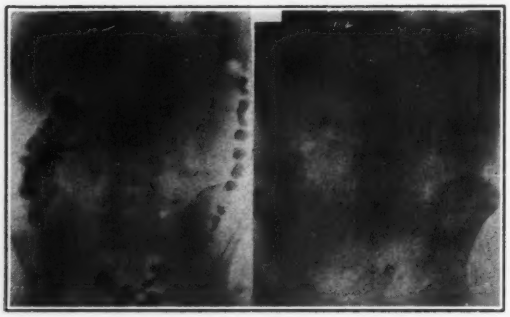

Fig. 6-*B*, Series III (*left*). Twenty-seven hours forty-five minutes after barium breakfast.
Fig. 6-*B*, Series IV (*right*). Twenty-eight hours forty minutes after barium breakfast and fourteen hours twenty minutes after 1 grain phenolphthalein.

nificant action after absorption. . . . The vegetable purgatives act through their irritant properties, which in some instances are elicited only by the action of the secretions of the intestines and of the neighboring glands. . . . The peristaltic movements of the intestine which move the contents along the canal arise from a complicated local reflex, which is aroused by the pressure of the contents on the sensory apparatus of the mucous membrane. This reflex may be increased (1) by anything that induces irritation of the mucous membrane and thus renders it more sensitive to the pressure of the contents, and (2) by increasing the bulk of the contents until they exert more pressure on the mucous surface. . . . In neither case is there any reason to suppose that the neuromuscular apparatus of the bowel is directly affected by the drugs; nor is the central nervous system implicated in the reflex, whether normal or exaggerated by the purgatives."

When considering the action of phenolphthalein his explanation was as follows:

"In the bowel it is dissolved by the bile and alkali and develops a mild irritant action in the small intestine and more distinctly in the large one. Most of the phenolphthalein administered by the mouth is not absorbed but appears in the stools. A small amount undergoes absorption and is excreted by the kidney. . . . It has a mild laxative effect when injected subcutaneously and this arises from its being excreted into the bile and thus carried to the gut. In the large intestine it is re-absorbed into the blood and again carried to the liver and returned to the gut. It, therefore, acts for several days as a mild aperient, but as it is gradually eliminated in the urine and stools, the action passes off."

Some earlier writers accounted for the action of the drug differently. Vamossy, in 1900, and Tunnicliffe, in

1902, were of the opinion that in the acid medium of the stomach phenolphthalein remains unchanged, but upon reaching the alkaline intestine it becomes converted into its sodium salt, which is more soluble and more active than phenolphthalein itself. According to Vamossy, this salt is possessed of a very low power of diffusion, which explains the purgative action in that, being indiffusible, its presence in the intestine occasions a high osmotic pressure and consequently a copious accumulation of fluid in the gut. The greater purgative action in man than in animals is explained on the supposition that in the latter the conversion into the sodium salt either does not take place at all or only to a very slight extent.

Since the work of Vamossy and Tunnicliffe on phenolphthalein was done, a great deal has been learned concerning the physiology of the digestive system. The movements of the various parts of the alimentary canal have been carefully and extensively studied, as have the numerous factors which influence them. This work is entirely too extensive and the number of workers engaged is altogether too great for any attempt to be made here even to touch upon the subject. Fortunately it is unnecessary to do so when addressing a group such as this, all of whom are more or less familiar with it. The X-ray and modern surgical technic have enabled investigators in this field to add wonderfully to our knowledge of digestive processes.

The same cannot be said in regard to the action of cathartics. The quotations from Dr. Cushny, one of the world's leaders in the field of experimental pharmacology up to the time of his death less than three years ago, prove that as recently as 1924 no great

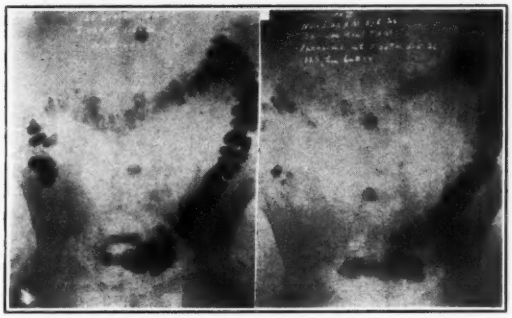

Fig. 7-*E*, Series III (*left*). Twenty-five hours forty minutes after barium breakfast.
Fig. 7-*E*, Series IV (*right*). Twenty-five hours twenty minutes after barium breakfast; twelve hours fifty minutes after 1 grain phenolphthalein.

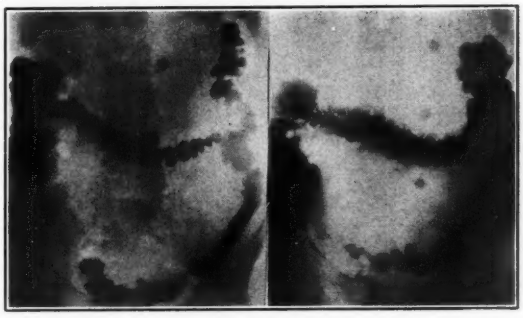

Fig. 8-*A*, Series VI (*left*). Twenty-four hours fifty minutes after barium breakfast.
Fig. 8-*A*, Series VIII (*right*). Twenty-four and one-half hours after barium breakfast; nine hours forty-five minutes after 2 grains phenolphthalein.

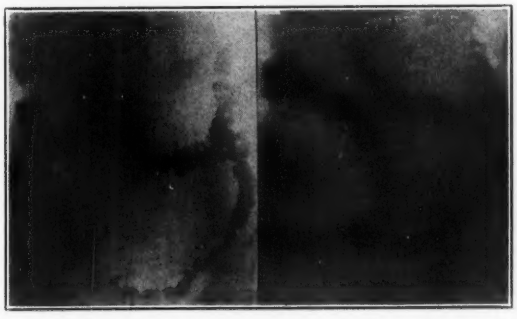

Fig. 9-*A*, Series I (*left*). Twenty-eight hours fifty minutes after barium breakfast.
Fig. 9-*A*, Series VIII (*right*). Twenty-eight hours after barium breakfast; thirteen hours fifteen minutes after 2 grains phenolphthalein.

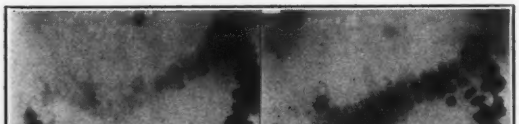

Fig. 10-*E*, Series III (*left*). Twenty-five hours forty minutes after barium breakfast.
Fig. 10-*E*, Series IX (*right*). Twenty-five and one-half hours after barium breakfast; one hour after 2 grains phenolphthalein.

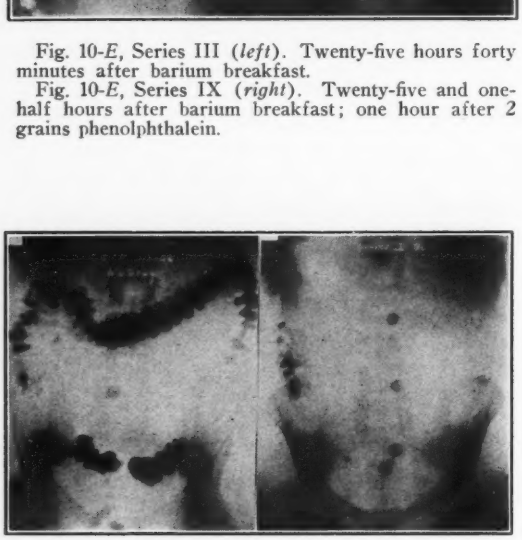

Fig. 11-*E*, Series III (*left*). Thirty-five hours after barium breakfast.
Fig. 11-*E*, Series IX (*right*). Thirty-four and one-half hours after barium breakfast; ten hours after 2 grains phenolphthalein.

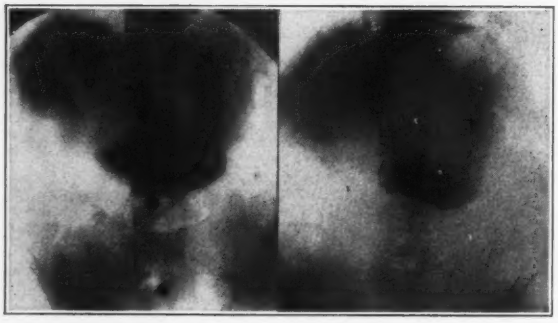

Fig. 12-*A*, Series XI (*left*). Three hours after barium breakfast.
Fig. 12-*A*, Series XII (*right*). Three hours after barium breakfast and 2 grains phenolphthalein.

progress had been made in our understanding of their actions. It is true that some very valuable work has been done, particularly in the clinical field, and the use of laxatives is more rational and more scientific than was the case even a decade or two ago. The progress which has been made in physiology has led to great advances in therapeutics and it seems that the time is now ripe for a stimulated interest in and a practical solution of at least some of the problems connected with the pharmacology and therapeutics of this group of drugs.

About three years ago we undertook to collect from the literature such data in regard to laxatives in general, and more particularly phenolphthalein, as might be of value in explaining the place and manner of their activity. We were surprised at how little we found. Many writers have concerned themselves with the general subject of constipation and its treatment and the relative merits of the different agents employed. We were impressed with the almost unlimited variety of products on the market and the hundreds of mixtures and combinations offered to those afflicted, apparently a very large part of the population.

However, we did not obtain the data we sought. Realizing the importance of such information we were influenced to undertake some work for the purpose of adding to this knowledge and, in view of our limited facilities, decided to begin with the roentgen ray. This seemed to offer us the best opportunity for early results and definite help with our problem. Very little work has been done along this line on the human—at least, we could not find much reported. Considerable has been done on animals, it is true, but because of their vastly different reactions to

these drugs, the results obtained are of doubtful practical value.

From 1908 to 1914 Dr. Arthur F. Hurst, of London, and his assistants carried on radiological investigations into the reactions of saline aperients, aloes, cascara, castor oil, calomel, senna, and liquid paraffin. More recently Prof. P. Alessandrini, of Rome, has made a series of experiments on the action of saline purgatives, the anthraquinone group (cascara, phenolphthalein, etc.), podophyllin, and castor oil, which he reported in 1925. He used barium sulphate in quite large dosage and made observations immediately and at repeated intervals up to forty-eight hours.

It would be of interest to quote from these reports but time will not permit. For the most part they agree, but there are sufficient differences to justify further work. They concerned themselves chiefly with the place and rapidity of action and had little to say in regard to the manner. Some statements are made which are not in accord with findings accepted as facts in this country, and the lack of complete data as to the time of administering the drug and the dosage used adds to the difficulties of interpretation.

As regards phenolphthalein, Prof. Alessandrini's conclusions are as follows:

"Phenolphthalein, which by its chemical constitution belongs to the anthraquinone group, behaves differently in its therapeutic effects. It has the advantage, like all laxatives in this group, of not irritating the gastro-intestinal membrane. Its action in doses of 20 cg. (about 3 grains) is that, while it does not modify the rapidity of evacuation of the stomach and first part of the small intestine, it stimulates specially the peristalsis of the ileum and cecum. Hence, in constipation of the ascending type (in the ce-

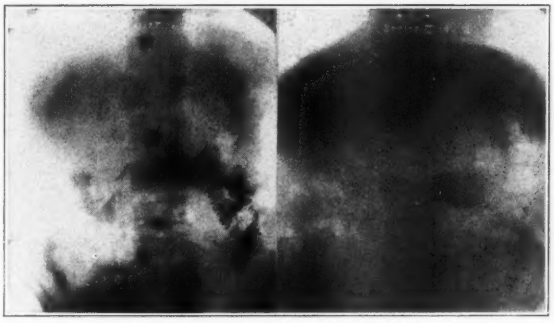

Fig. 13-*A*, Series XI (*left*). Four hours fifty minutes after barium breakfast.
Fig. 13-*A*, Series XII (*right*). Four hours forty-five minutes after barium breakfast and 2 grains phenolphthalein.

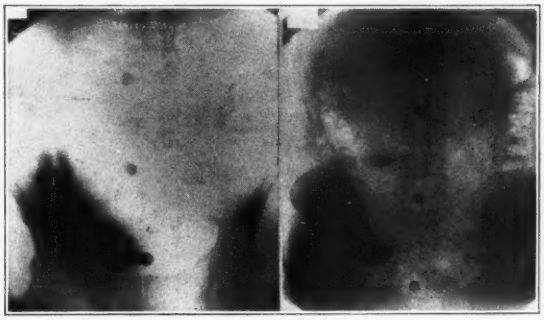

Fig. 14-*A*, Series XI (*left*). Seven hours forty minutes after barium breakfast.
Fig. 14-*A*, Series XII (*right*). Seven and one-half hours after barium breakfast and 2 grains phenolphthalein.

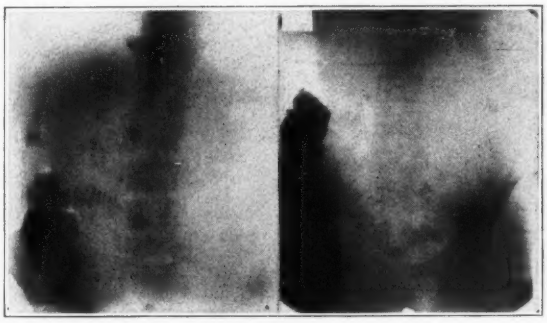

Fig. 15-*A*, Series XI (*left*). Ten hours after barium breakfast.
Fig. 15-*A*, Series XII (*right*). Ten and one-half hours after barium breakfast and 2 grains phenolphthalein.

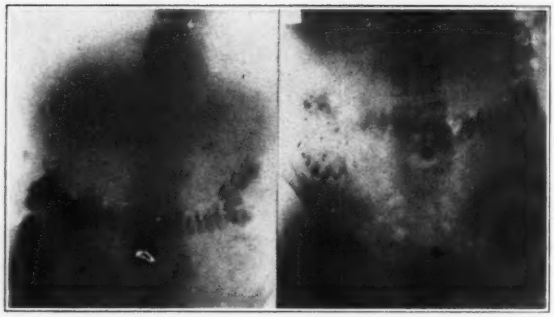

Fig. 16-*A*, Series XI (*left*). Twenty-eight hours twenty-five minutes after barium breakfast.
Fig. 16-*A*, Series XII (*right*). Twenty-eight hours forty-five minutes after barium breakfast and 2 grains phenolphthalein.

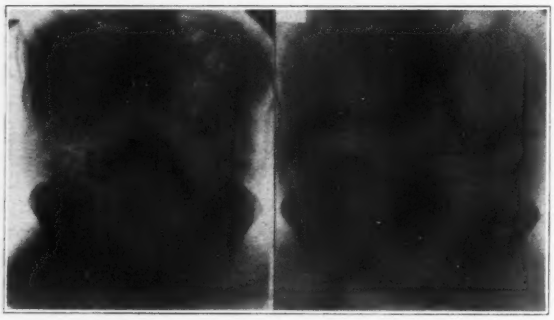

Fig. 17-*E*, Series XI (*left*). Three and one-half hours after barium breakfast.
Fig. 17-*E*, Series XII (*right*). Three hours thirty-five minutes after barium breakfast and 2 grains phenolphthalein (yellow).

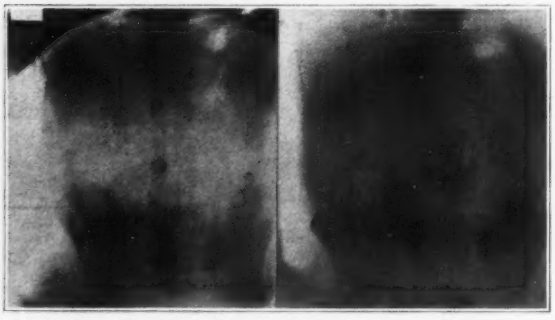

Fig. 18-*E*, Series XI (*left*). Five hours fifteen minutes after barium breakfast.
Fig. 18-*E*, Series XII (*right*). Five hours ten minutes after barium breakfast and 2 grains phenolphthalein (yellow).

cum and ascending colon) it is the ideal purgative, since, moreover, it does not cause pain and its action is manifest after three or four hours, as soon as the gastric contents have reached the cecum."

Our first group of observations were made with the technic which is commonly used by radiologists in making a study of the stomach and intestine for disease. About three ounces of barium sulphate were given in a glass of water during or immediately following a light breakfast, and observations were made during that day and the next. Several subjects were used, all of them healthy men, and a record was kept of the diet, time of X-ray exposures, bowel movements, etc. After about two weeks a second barium breakfast was given, identical with the first and in every possible way the conditions of the first experiment were repeated, with the exception that each subject was given one grain of phenolphthalein immediately following the meal. Each figure shows two films, one of each series, taken at corresponding intervals after the barium meal. Figures 1 to 5 are made of Subject A and give quite definitely the location of the barium at intervals of approximately one hour, five hours, ten hours, twenty-eight, and thirty-four hours, respectively, after the meal. They show quite clearly that the rate of movement of the food mass taken at the same time as the grain of phenolphthalein was not materially affected by the drug. Other subjects showed the same results, the slight variations which did occur being as often in one direction as in the other, and obviously due to some other factors.

The next group of figures was made under conditions identical with the first except as to the time of administering the drug. The controls were

made in exactly the same way; in fact, some observations were made on the same subjects, and with these the same controls were used. The phenolphthalein was taken in the evening following the barium breakfast, about twelve to fifteen hours after the meal, by which time the mass of food and barium was well on its way. Figure 6 shows the relative positions of the barium in Subject B under normal conditions and after phenolphthalein, twenty-eight hours after the meal, fourteen hours after taking the drug. You will observe a marked difference here; the rate of movement has been greatly accelerated, the barium being practically all excreted when this film was made.

The next subject shows a different result. The meal was the same, other conditions were as nearly alike as we could make them, the only difference being the subject. Figure 7 was made of Subject E, twenty-five hours after the meal, twelve hours after the phenolphthalein. At the end of twelve hours, by which time the laxative action has practically ceased, apparently all of the barium is still in the colon.

The next two Figures, 8 and 9, show the results in Subject A. The same conditions were observed with the exception that two grains of phenolphthalein were given instead of one. The films were made twenty-four and twenty-eight hours after the barium meal, nine and thirteen hours after the drug. In this case also the rate of movement is practically unchanged.

In the next group of experiments the only change made was in the time of administering the laxative. Figures 10 and 11 show the effects in Subject E of giving the phenolphthalein after breakfast the following morning, twenty-four hours after the barium meal. These films were made twenty-five

Fig. 19-*E*, Series XI (*left*). Eight hours after barium breakfast.
Fig. 19-*E*, Series XII (*right*). Eight hours (less five minutes) after barium breakfast and 2 grains phenolphthalein (yellow).

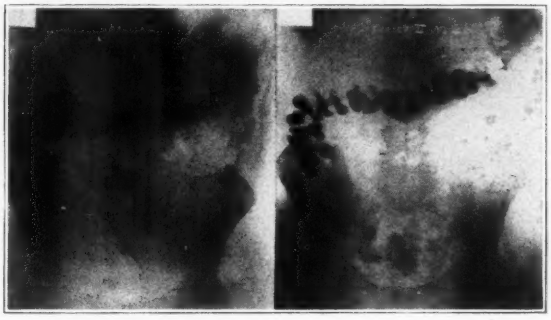

Fig. 20-*E*, Series XI (*left*). Ten and one-half hours after barium breakfast.
Fig. 20-*E*, Series XII (*right*). Ten hours twenty-five minutes after barium breakfast and 2 grains phenolphthalein (yellow).

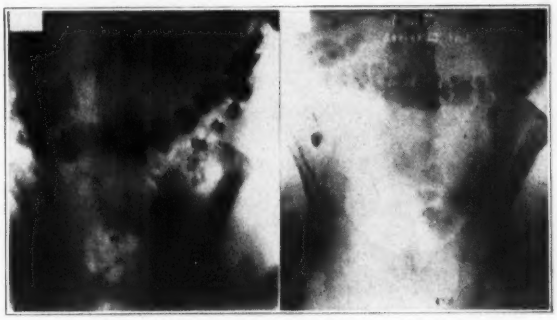

Fig. 21-*F*, Series XI (*left*). Twenty-four hours forty-five minutes after barium breakfast.
Fig. 21-*F*, Series XIII (*right*). Twenty-five hours after barium breakfast; ten and one-half hours after 1½ grains phenolphthalein.

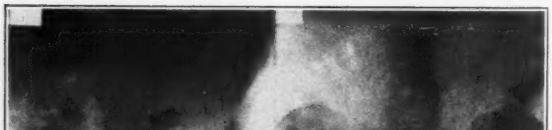

Fig. 22-*F*, Series XI (*left*). Twenty-eight hours forty minutes after barium breakfast.
Fig. 22-*F*, Series XIII (*right*). Twenty-eight hours forty-five minutes after barium breakfast; fourteen hours fifteen minutes after 1½ grains phenolphthalein.

Fig. 23-*F*, Series XI (*left*). Thirty-three hours fifty minutes after barium breakfast.
Fig. 23-*F*, Series XIII (*right*). Thirty-three hours forty-five minutes after barium breakfast; nineteen hours fifteen minutes after 1½ grains phenolphthalein.

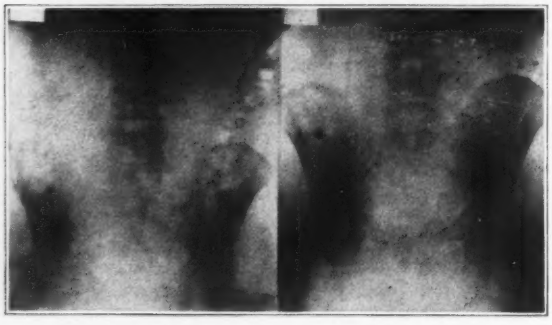

Fig. 24-*F*, Series XI (*left*). Forty-eight hours forty-five minutes after barium breakfast.
Fig. 24-*F*, Series XIII (*right*). Forty-eight hours fifty minutes after barium breakfast; thirty-four hours twenty minutes after 1½ grains phenolphthalein.

hours and thirty-four hours after the meal, one hour and ten hours after the drug. Evidently something has caused a marked increase in the elimination of the contents of the distal colon.

After proceeding to this point in our work we were forced to the conclusion that our technic was not satisfactory. Prof. Alessandrini's statement to the effect that the barium sulphate does not affect the intestinal movements was not borne out by our experience. Our subjects showed quite a marked laxative action from the barium, particularly after it had been used two or three times. The effects were so variable, not only as between different subjects, but in the same subject at different times, that we could not be sure whether the increased motility was due to the phenolphthalein or to the barium sulphate. While we were reasonably certain that we had avoided serious error by discarding all films in which there was evidence of excessive purgation, we wanted to verify our results by some method free from this objection.

After testing several methods which were suggested, we finally repeated the work on a rather large scale with about a dozen different subjects, using for our opaque medium a small quantity, about half an ounce, of barium sulphate, taken in three doses about an hour apart, together with one hundred small round pills containing bismuth subnitrate and covered with an insoluble coating. The films shown in the following Figures were made according to this technic. We modified the time intervals at which the exposures were made and increased somewhat the number of observations made in each series. Each experiment was carried out on several subjects and efforts were made to maintain the conditions uniform and the records complete. In this

group over two hundred films were made, in the first about one hundred twenty-five.

The next nine Figures, five of Subject A, four of Subject E, Nos. 12 to 20, inclusive, show the effects on the food mass of a laxative dose of phenolphthalein taken at the same time as the meal and which undoubtedly remains intimately mixed with this mass throughout its passage through the canal. The four Figures, Nos. 21 to 24, were made of Subject F. He took the laxative in the evening following the barium breakfast, after the mass had reached the cecum and ascending colon. In the third group, Figures 25 to 27, the drug was taken on the following morning, twenty-four hours after the opaque meal, and when, according to numerous observations, the mass had reached the middle or distal half of the colon. In each of these subjects a laxative effect from the phenolphthalein was noted at about the usual time, within six to twelve hours, and bowel activity was practically normal thereafter, though phenolphthalein could be demonstrated in the stools for three or four days.

When the drug is taken with the meal the laxative effect occurs before the mass has passed the hepatic flexure and has ceased while the greater portion still is in the colon. It was repeatedly shown in these subjects that, under these conditions, the rate of flow of the accompanying food mass does not vary materially from normal. In the second group, those to whom the drug was administered in the evening following the meal, the effects varied. Individuals of this group in whom the food mass moved quite rapidly, causing it to reach the distal colon in twenty-four hours or less, showed early elimination of a large part of the

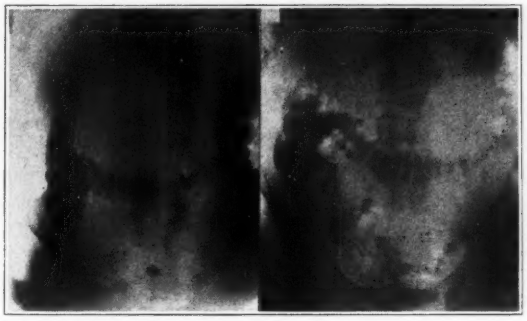

Fig. 25-*A*, Series XI (*left*). Twenty-four hours fifty minutes after barium breakfast.
Fig. 25-*A*, Series XIV (*right*). Twenty-five hours after barium breakfast; one hour after 1 grain phenolphthalein (yellow).

Fig. 26-*A*, Series XI (*left*). Twenty-eight hours twenty-five minutes after barium breakfast.
Fig. 26-*A*, Series XIV (*right*). Twenty-eight hours fifty-five minutes after barium breakfast; four hours fifty-five minutes after 1 grain phenolphthalein (yellow).

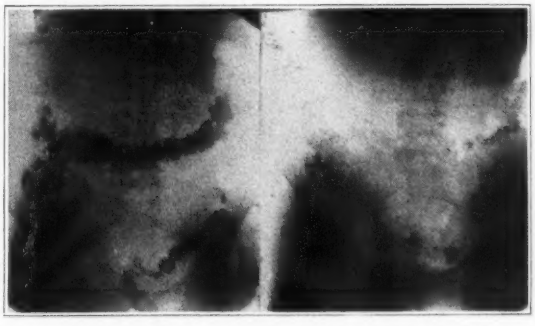

Fig. 27-*A*, Series XI (*left*). Thirty-three hours fifty minutes after barium breakfast.
Fig. 27-*A*, Series XIV (*right*). Thirty-three hours fifty minutes after barium breakfast; nine hours fifty minutes after 1 grain phenolphthalein (yellow).

opaque material. In those with less motor activity the laxative did not appear to alter the rate, at least to any great extent. Evidently it depends on the portion of the digestive tract occupied by the mass at the time the phenolphthalein becomes active.

Those subjects who took the laxative drug the following morning practically all showed a very rapid emptying of the distal colon as compared with the normal rate. By the time the drug taken twenty-four hours after the meal had become active the food mass, even in those whose rate was slow, had reached the distal half of the colon, which is the chief if not the only portion of the digestive tract stimulated by phenolphthalein.

After careful study of our films together with some other evidence which we cannot enter into here, we have come to several conclusions based on this evidence. They seem to us to be consistent with known facts, but, of course, may have to be abandoned in the light of new knowledge. We believe that at least some of the differences between our results and those of earlier workers are due to smaller dosage and a purer drug. We have done some work with a by-product separated from phenolphthalein, which is twelve to fifteen times as active as phenolphthalein and differs from it somewhat in its effects.

Our conclusions are as follows:

1. Phenolphthalein in ordinary dosage has no appreciable effect on the movements of the stomach or the small intestine.

2. Phenolphthalein does not directly affect the rate of movement, in any part of the digestive tract, of the food material taken simultaneously with it.

3. The proximal half of the colon shows very little, if any, increase in its motor activity during the period in which phenolphthalein is most active, about eight to twelve hours after it is taken.

4. The movements of the distal half of the large intestine are strongly stimulated by phenolphthalein during its active period.

5. Phenolphthalein has no local effects in any portion of the alimentary canal due to chemical or mechanical action on the bowel wall.

6. The drug is in part absorbed during its passage through the small intestine and re-excreted into the colon or large bowel.

7. The laxative properties of phenolphthalein are due chiefly if not entirely to a stimulation of the large bowel by that portion of the drug which is absorbed and carried by the blood to this portion of the tract.

8. Only that portion of the intestinal contents which has reached the distal colon by the time the phenolphthalein becomes active, namely, about eight to twelve hours after its ingestion, is directly influenced by it. Other apparent effects are secondary and indirect.

THE PROGRESS OF ROENTGENOLOGY IN THE ARMY[1]

By LIEUT.-COL. H. C. PILLSBURY, M.C., Station Hospital, Fort Sam Houston, Texas

RADIOLOGY in the Army occupies a prominent position. In every post, however small, X-ray apparatus is used extensively, while in the larger posts, and in the seven general hospitals, the interest in roentgen diagnosis and treatment is keen. It is not confined to the few who specialize, as it has been the policy to disseminate knowledge of radiology among all members of the Medical Department. Ward surgeons are not content to read reports, but visit the roentgen department daily to check their clinical findings directly from the X-ray film. In the larger institutions the X-ray films are displayed at all postmortems and the gross pathologic findings compared with the shadows shown. This interest is the logical outcome of the training schedule; as no man who understands this specialty and who has learned to read his films intelligently will ever be without this aid to diagnosis and guide to the efficiency of treatment.

It might be thought that with such dissemination of knowledge doctors would be content to dispense with the services of a specialist—would be satisfied with the excellent films produced by well trained technicians. This is not true. The demand for the X-ray specialist has increased, and can hardly be met. The clinician well versed in "reading" films is not, it is true, content with the written description only: he demands the description, the findings, and the film itself. He requires the trained observation to guide him.

We have followed, in the Army, the usual procedure found so successful in civil practice: our dental surgeons make and interpret their own radiographs.

Likewise, we have advanced in veterinary radiology. Our veterinarians have been trained to take radiographs on small animals and the extremities of horses, and have developed so that they are able to make accurate diagnoses and prognoses. They have advanced further than any other group.

Our system of training may be of interest to you. All Medical Department officers pass through the course in Basic Training, which includes six months in the Army Medical School at Washington and three months in the Field Service School at Carlisle. To date, of the 937 medical officers, 579 have been graduated. Included in the Army Medical School curriculum is the course in Radiology. The comparative value of this course, in hours allotted and credit toward graduation, is on a parity with General Medicine and Surgery. Medical officers are taught enough electricity to enable them to understand the principles of X-ray physics and the operation of X-ray machines. They are required to take radiographs of all parts of the body, so that, if stationed at a small post, they may produce their own radiographs. The greatest stress is laid on film interpretation, which is limited to the conditions usually encountered in a busy practice. The Department is provided with a room containing twenty stereoscopes, in addition to other rooms supplied with viewing boxes. On each class day there is a short lecture on a definite subject, followed by demonstration of films illustrating different gradations of that condition. The student has adequate time to inspect the films carefully. Films of other diseases that cast similar shadows are shown, and the differences illustrated. The recognition of the normal is stressed throughout the course. No attempt is made to teach the diagnosis of gastro-intestinal disease, as that

[1]Published with permission of the Surgeon General, U. S. Army, who is not responsible for any opinion expressed or conclusions reached herein. Read by the author before the Thirteenth Annual Meeting of the Radiological Society of North America, at New Orleans, Nov. 28–Dec. 2, 1927.

depends so largely on fluoroscopic study as to be beyond the scope of the average physician.

The instruction for officers of the Dental Corps is limited to the apparatus they will use and to the interpretation of diseases of the teeth. This course is practical throughout and has been given to nearly half of that Corps.

The veterinary officers receive a course that will enable them to take radiographs on small animals and on the extremities of horses, and interpret their findings. The interest they have shown and their success after leaving the school have been most gratifying. Of the 118 officers of the Veterinary Corps, 84 have been graduated.

Our larger hospitals require the services of X-ray specialists. For their training there is established a four-months course at the Army Medical School. The applicants are carefully selected, and the classes limited to six. Training is on X-ray physics, the installation, maintenance, and repair of X-ray apparatus, and the diagnosis of chest and gastro-intestinal conditions. The instruction includes the rarer forms of disease. The course has been given to 14.

To broaden our outlook, and to keep in intimate touch with our colleagues in civil practice, selected individuals are sent from time to time to civilian institutions for courses ranging from six months to a year. To date, this training has been given to nine. After a medical officer has completed his specialist course he is sent, when possible, as assistant to a more experienced man. After that he is given charge of a clinic in a General Hospital. It is the plan to leave the younger men on radiology for not more than five or six years, and then withdraw them for a brief period of clinical work in the wards.

Including the men inherited from the War and trained immediately after it, there is now a sufficient number of trained radiologists to supply our larger hospitals. This number is being continually depleted by purposeful withdrawals to clinical work: the specialists' training continues to be active.

Enlisted technicians are trained at the Army Medical School. The course includes one month of elementary electricity, one month on maintenance and repair, and one month on radiographic technic. Only those soldiers who receive an average grade of 80 per cent in the weekly written quizzes are given certificates. To date, 279 soldiers have been trained. After graduation they are returned to their posts, where they have turned out excellent work and kept their apparatus in good order. Upon their discharge from the service a register is kept showing their grade at school, their proficiency at the post to which they were sent, and their address.

PERSONNEL

In the event of war the Medical Department must have a sufficient personnel to conduct the physical examination of inducted men and to care for them thereafter.

Individual effort is inefficient: there must be team-work, a co-ordinated effort from highest to lowest. It is to provide for this that the Medical Reserve Corps exists in such splendid form. We know, all of us, that when the emergency arises our profession will do its part, will come to perform its bit in the whole that is an efficient Army. In the confusion incident to all wars many of these individuals would not be fitted to their proper positions; many would be assigned to subordinate places, under men inferior to them in ability and professional attainments. We hope that, should war occur, the confusion will be minimal, but that it will exist we are only too well aware.

The Medical Reserve Corps, a body of as patriotic men as can be found in any coun-

try, at any age, offers the solution of the problem. It takes years of slow, steady, progressive work to place men where they can be used to best advantage. The Reserve Corps has given us more than that: It has supplied for our country the complete officer personnel of whole units, ready in the great emergency to undertake their responsibilities smoothly and efficiently. In no way can I express our appreciation of the sacrifice of time and recreation that these officers are making, year by year, that they may be fitted to do their patriotic duty in the time of their country's need.

Let us consider only the radiological standpoint. Take the General Hospitals: perhaps no one position is more difficult to fill than that of radiologist. That seems a strong statement, but analyze the situation. The radiologist has referred to him, as consultant, patients from every service and from every ward. Considered as pure science, that should present no difficulty, but with us the personal element bulks large. We furnish our colleagues a written description and deduction. The clinician uses both in evaluating the diagnosis and method of treatment. We never use a common language, nor are our descriptions invariably accurate: for example, what one person considers large, another may conceive of as moderate or even small. When time permits, the radiologist and his colleagues come to an understanding: each conforms his ideas to those of the other. But in war, there is no time for this adjustment. The General Hospitals, nearly empty one day, may be filled to capacity the next week. In the stress of caring for a ward filled mostly with new patients the Ward Surgeon has no time to confer with the radiologist, who, on his part, is so occupied with new assistants, strange apparatus, and an unusual environment that he may even resent the visits to his department that block his efforts at systematic work.

It is here that the Reserve Corps is so valuable. The members of a formed unit know and understand each other during the years of peace, and function as a team in an emergency. Of the 146 General Hospitals that have been formed or are forming, radiologists are assigned to 87.

The radiologist should take the regular correspondence courses. He needs to know the Army system of evacuation, how battles are fought, how the Army is made up and functions. Only with such knowledge can the man surrounded by his apparatus give full and intelligent assistance to the work of the whole.

This is especially true of the Evacuation Hospitals, which are pushed well up into the zone of the combat forces. Here the radiologist meets war at closer hand. It would be mortifying to him to be ignorant of the "big idea," to be unaware of what it was all about. Here he will find the value of the hours he devoted to study during time of peace. We are able to report progress. Of the 90 Evacuation Hospitals, 36 are provided with men of our specialty.

In the last Medical Department formation to be considered, the 72 Surgical Hospitals, the progress has not been as good. Only 23 are complete. It is probable that here, where the problem is limited to the localization of foreign bodies solely, the radiologist can be supplied from a general stock, as it were, and function with a fair assurance of success.

In addition to those definitely assigned to units, there is a reserve of 84 radiologists who have not been assigned, bringing the total in the Medical Reserve Corps to 244.

The plans are complete for the training of radiologists at the outbreak of war, based on the highly successful school established at Oglethorpe in 1917-1918. The plans are detailed to the last degree, the size of the classes, the number of instructors, the number of enlisted attendants, the material re-

quired, even the subjects covered each hour. Here will be trained young men to act as assistants to the more experienced officers and to fill positions in the advanced units.

Most gratifying progress has been made with the Sanitary and Medical Administrative Reserve: 37 officers are enrolled, men well known, of sound technical training, who will furnish a nucleus for the force that will provide adequate supervision over the production of X-ray supplies, and will install and maintain them properly.

PROCUREMENT OF SUPPLIES IN THE EVENT OF WAR

It is obvious that it would be unwise as well as impracticable to maintain any considerable reserve stock of supplies. Such a stock is liable to deteriorate, and apparatus becomes obsolete. After the World War there was created an Assistant Secretary who established a bureau for the procurement plans on all manner of supplies required in time of war. Assigned to this division were a large number of officers taken from every branch of the service. These officers were selected with great care and most of them have been given a special course of instruction designed to fit them for this highly important duty. The problem may be divided into several phases: First, given an Army of the size decided upon by the War Plans Division of the General Staff, what are the requirements month by month in supplies of every nature? The second phase, having obtained the requirements, is to determine what firms can manufacture these supplies, so that delivery in proper quantities and amounts shall be assured. As a corollary, it is essential to formulate accurate specifications for every article, so that the manufacturers will know exactly what they may be expected to deliver. The third step is the allocation to each manufacturer of his share in the program, so that he shall know what he may be called upon to deliver month by month during the period of the war. The next step is the personnel requirement of each factory, so that the production program shall not be handicapped by withdrawal of men for the combat forces. The final phase is the allocation of raw material, coal, iron, etc., so that the factories shall receive without fail the material from which the supplies are to be made. Each step of this program is equally important. While the study is not completed, great progress has been made. So far as X-ray supplies are concerned, the requirements for the Army have been completed. The production capacity of the factories is on file; each firm has been allocated a definite list of supplies it will furnish in event of war.

All this would have been utterly impossible had it not been for the full co-operation of the commercial firms. Every maker of X-ray supplies has furnished the War Department a detailed, accurate, and voluminous study of the production capacity of his plant, both at present and after expansion. Every firm has given the War Department its hearty support in this difficult program.

It has been a great pleasure to have this opportunity of appearing before you to give an account of the progress of roentgenology in the Army. It is abundantly evident that such progress has been made possible by the cordial relations existing between the Medical Corps and our colleagues in civil practice.

THE SIGNIFICANCE OF A FAINT SHADOW IN ORAL CHOLECYSTOGRAPHY[1]

By C. S. OAKMAN, A.B., A.M., M.D., MUNCIE, INDIANA

IT has generally been held that cholecystography by the oral method is less reliable than by the intravenous method. However, for various reasons there are many roentgenologists who prefer to use chiefly the oral method and to acquire whatever skill is possible in interpretations made therefrom. Statistics show that a high degree of accuracy has been developed by some of these men, and that their diagnoses of impaired gall-bladder function are based not only on an absent dye shadow but also on a faint shadow. In the literature, however, we find many warnings against diagnoses predicated upon *faint* shadows.

Sosman and associates, in 1925 (1), said that a faint or absent shadow by the oral method must be confirmed by intravenous injection. Whitaker, in 1927 (2), stated that too much reliance cannot be placed on the interpretation of pathology from a *faint* shadow. In the book written by Graham and his associates, in 1928 (3), they attach great importance to a faint shadow by the intravenous technic, but "feel that this sign is to be ignored in oral administration."

If it were really necessary to ignore a faint shadow, there would be many failures of diagnosis by X-ray. In a series of 305 cases receiving the dye test, which I reported last year (4), there were 162 X-ray diagnoses of pathologic gall bladder, and 72 of these were based on faint shadow as against only 65 showing an absent shadow. Of the entire series, 37 cases came to section, all but one having a confirmation of the roentgen diagnosis, which was based on faint shadow 17 times and on absent shadow 14 times.

In a current series of 180 cases, I ventured a diagnosis of gall-bladder pathology in 87 instances, 28 of which were based on a faint shadow without evidence of stones, and 34 were based on absent shadow. If in these two series I had not dared to diagnose cholecystic disease from a faint shadow, there would have been 106 fewer diagnoses of pathology. To be sure, only a few of them came to section (13 in all), but they were all proved correct. It should be added that this group does not include cases of calculi, as their presence would manifestly make the diagnosis easy. The 13 cases above mentioned constitute about 20 per cent of the entire series operated on, and if the roentgen diagnosis had not been made it would have been a serious arraignment of the cholecystographic test.

In this connection it should be mentioned that in six cases a shadow of normal density has not prevented the prognostication of gall-bladder pathology, proved at operation; these were mostly thickened organs, some of them contracted, some with adhesions, and none with calculi.

There have been many efforts to define the term "faint shadow" and to describe gradations of density, from normal to complete absence of dye shadow. However, it is not yet possible to define satisfactorily the "normal" degree of density, and perhaps it is fruitless to attempt it, for every individual is a law unto himself, and the roentgenologist must for the present consider the individual rather than a rigid standard.

The causes of a faint shadow in oral cholecystography are the same as the causes of an absent shadow, and have been well ex-

[1]Read before the Radiological Society of North America at the Fourteenth Annual Meeting, at Chicago, Dec. 3–7, 1928.

plained by many authors. They may be classified as follows:

1. *Causes due to defective dye or vehicle.*—A good shadow will be lacking if the dye is impure, or has suffered chemical change from any cause, or is exhibited in a vehicle that impedes its assimilation. Capsules sometimes fail to disintegrate or the contained dye acquires a surface inspissation that prevents its solution. If capsules are used, a preliminary large film always gives a clue to the degree of disintegration.

2. *Causes due to violating directions.*—If the patient does not follow directions, there may be a vitiation of the test. Ignorant patients are especially untrustworthy and have even been known to throw the dye away, or take it a day too soon. All sorts of violations of directions occur, and one must be constantly alert to inquire on this point, and, if errors occur, be able to judge the consequent effect upon the test and the advisability of repeating.

3. *Causes due to dye reactions.*—If the patient has emesis or diarrhea after ingestion of the dye, it may impair the test, especially if it occurs within the first hour and a half after ingestion. Careful inquiry will sometimes disclose the reason for emesis, for example, a failure to remain quiet during the evening, or a repugnance for soda, when it is used, or the coincident occurrence of pain. A repetition of the test will usually be successful. Personally I have had only three failures, one due to hyperemesis gravidarum, one to hyperthyroidism, and one apparently to persistent pylorospasm.

4. *Causes due to faulty assimilation.*—These causes may be due to physiologic or pathologic conditions. Pregnancy appears to interfere with the test, especially in the late months. Eusterman (5) states that in about 10 per cent of cases the normal gall bladder gives a pathologic response, and that a failure of shadow should always be carefully estimated in patients of asthenic, ptotic, or neurotic type, with hypoacidity, or with a diminished basal metabolism, and in cases of *hyper*acidity, especially with duodenal ulcer.

Hines (6) has found that a shadow may not develop in cases of achylia gastrica.

In Graham's book mention is made that no shadow is seen when jaundice exists, and Alexander and Bond are quoted as saying that hepatic enlargement from any cause will prevent visualization. Retention of the dye by esophageal or pyloric stenosis sometimes occurs, and then, of course, no shadow is seen, because the dye is not absorbed under such conditions.

It is not advisable to carry out the test with patients who are suffering from an acute illness of any kind.

5. *Causes due to poor technic.*—Films of poor quality will invalidate the test, and occasionally the optimum hour of dye concentration will be passed. These errors and their remedy are self-evident. Satisfactory technical work is very difficult in heavy individuals of hypersthenic type.

6. *Causes due to gall-bladder disease.*—These causes comprise two major classes: first, occlusion of the gall bladder by cystic duct obstruction, such as calculus, inflammation, or neoplasm, or a vesicle filled with stones, debris, or inspissated contents; second, a diseased mucous membrane which prevents concentration of the bile and its contained dye. There have been various attempts to correlate the cholecystographic response with the degree of pathology; in this attempt two different factors confuse the issue, namely, the degree of disease as estimated from a strictly pathologic viewpoint, and the severity of the symptoms. We know that severe symptoms are frequently no index of the degree of gall-bladder damage, and Mentzer's analysis (7) shows that surgery should be based on clinical symptoms rather than pathologic changes.

If one perceives the pitfalls of a given procedure, he learns how best to evade them. The oral method is manifestly beset with

uncertainties, but there are ways of solving them and attaining a considerable degree of accuracy. Unfortunately our mistakes are mostly buried in that large proportion of cases which we report as cholecystitis, but which do not come to operation, either because the patient declines, or the physician disagrees with us, or because the surgeon for some reason refuses to operate. Our percentage of accuracy in any table of cases operated on will remain high when we work for competent surgeons, because they accept the roentgen report as only one among several factors which they must consider. There is food for thought in Eusterman's (5) contention that his clinical diagnosis, independent of X-ray, is seldom wrong in cases that come to operative proof.

In oral cholecystography, then, one must first be sure of the quality of the dye; he should then closely question the patient to learn whether directions have been observed and whether vitiating reactions have occurred. If dye appears in the alimentary tract undissolved, a subnormal shadow should be cautiously interpreted and the test perhaps repeated. The dye in solution eliminates this particular difficulty. Good management of the patient and good radiographic technic are essential. After all these factors have been appraised, the finding of a faint shadow needs careful study, in order to decide whether the patient has a physiologic phase that accounts for it, or whether it is one of the borderline types that we occasionally meet. This being settled, we use whatever means we can to guess whether an enlarged liver or occluded hepatic duct is present, though this has been rare in my experience. The line of investigation finally leads to the gall bladder itself, and a study of all the films, to estimate intensity, effect of fat meal, and finally the correlation of data from the barium meal, which still has great value. It has been helpful in so many cases that I do not omit it, except in rare cases. The likelihood that a faint shadow signifies disturbed function is increased if the shadow is late in developing, or persistent after a fat meal. In the interpretation of a case up to this point, it is well to preserve a purely objective standpoint, and not delve too deeply into anamnesis, or collateral clinical data. The concluding step, however, requires the roentgenologist to consider every aspect of the case and, if possible, to confer with the clinician. In a few cases this last step has caused me to reconsider an objective finding of cholecystitis and to repeat the test, sometimes with a confirmation of the original opinion and sometimes with a modification of it. The fundamental meaning of the dye test must be constantly kept in mind, namely, that it is a test of function, and that the predication of pathology proceeds only as an inference. The roentgenologist must use all possible means to justify such an inference, and then express his opinion. In many communities the roentgenologist cannot escape with a mere statement as to gallbladder function, but is expected to give a definite opinion as to the probability of intrinsic pathology. It has proved helpful to be personally in very close touch with all steps of cholecystographic work. The verification of all data by the roentgenologist himself gives a feeling of security that is obtainable in no other way, and this includes personal interviewing of the patient and performance of the fluoroscopic examination.

In the course of tabulating the present series, a few statistics were developed. There were 180 persons who received the dye test, with repetition in 21 cases, or a total of 201 dye administrations. There were 86 males and 94 females, the males having 9 and the females 12 repetitions. The reasons for repetition were: vomiting, 5; diarrhea, 5; undissolved dye, 3, and in 8 cases the existence of data that seemed incompatible with cholecystitis. The repetition confirmed the first test 12 times, and

7 times it was contradictory, while in 2 cases the dye was vomited each time.

The dye was given in enteric-coated capsules 119 times, in emulsion 77 times, and the remainder in dry powder form in water. I never use the intravenous method.

Vomiting and diarrhea occurred in a far greater proportion of hospitalized cases than in ambulant cases. I have concluded that this is because the hospitalized patients are usually sick and more easily upset, physically and psychically.

A record of the patient's reaction to the dye was kept in 187 administrations:

No disturbance	73 or 39 %
Nausea only	37 or 19.8%
Vomiting	15 or 8.0%
Diarrhea only	38 or 19.8%
Nausea and diarrhea	18 or 9.6%
Vomiting and diarrhea	6 or 3.2%

In condensed form this table shows:

Nausea alone or with other disturbance	76 or 40.6%
Vomiting alone or with other disturbance	21 or 11.2%
Diarrhea alone or with other disturbance	62 or 33.2%

In "diarrhea" was included any case that had one or more defecations of a loose character in the interval between taking the dye and reporting for the first films. The defecations varied from one (common) to a dozen (rare). No repetition of the test was made on account of diarrhea unless it began within one and a half hours after ingestion of dye.

The dye in capsule form, 110 administrations:

No disturbance	43 or 39.1%
Nausea only	28 or 25.5%
Vomiting	11 or 10.0%
Diarrhea only	16 or 14.5%
Nausea and diarrhea	9 or 8.2%
Vomiting and diarrhea	3 or 2.7%

In condensed form the preceding table shows:

Nausea alone or with other disturbance	51 or 46.4%
Vomiting alone or with other disturbance	14 or 12.7%
Diarrhea alone or with other disturbance	28 or 25.4%

The dye in emulsion form, 71 administrations:

No disturbance	27 or 38 %
Nausea only	8 or 11.3%
Vomiting	4 or 5.7%
Diarrhea only	21 or 29.6%
Nausea and diarrhea	8 or 11.3%
Vomiting and diarrhea	3 or 4.2%

The preceding table in condensed form shows:

Nausea alone or with other disturbance	20 or 28.1%
Vomiting alone or with other disturbance	7 or 9.9%
Diarrhea alone or with other disturbance	32 or 44.8%

These tables show the capsules tending to produce vomiting relatively often and the emulsion tending to produce diarrhea.

The series reported last year are compared and combined herewith:

	Old series	New series	Total
No disturbance	102	73	175 or 42.1%
Nausea	72	37	109 or 26.3%
Vomiting	25	21	46 or 11.1%
Diarrhea	29	56	85 or 20.5%
	228	187	415

Records are available of 27 cases operated on in which a roentgenologic diagnosis of gall-bladder pathology was made. The surgeons found cholecystic disease in every case, removing the viscus in 26 cases. The X-ray report mentioned mottling as indicative of calculi in two cases where they were not found at operation. The surgeons found calculi in 12 cases in which the X-ray examination failed to reveal them; in 8 of these the dye test resulted in no shadow, and in 4 there was a very faint shadow, but with no visible mottling. The X-ray correctly reported gallstones in 8 cases. In 3 cases the cholecystogram was of normal density; in one of them the shadow was small and distorted, and the barium meal gave unmistakable indirect signs of gall-bladder pathology; in another the shadow was of normal shape, but the barium meal was pathognomonic; in another the shadow was persistent and the barium signs were confirmatory.

There were 7 cases that came to opera-

tion, in which no gall-bladder pathology was suspected by X-ray, and the surgeon palpated or inspected the gall bladder, or both, and believed it to be normal. The conditions found by the surgeons in these 7 cases were: 2 chronic appendices, 1 mesenteric tumor, 1 fibroid, 1 metritis, and 2 cancer of the pylorus, the latter being correctly diagnosed by X-ray.

SUMMARY

1. A faint shadow resulting after the oral Graham test has a high degree of diagnostic value.

2. The oral test has many possibilities of error, which should be considered in every case. The errors may be due to (*a*) defective dye or vehicle; (*b*) violation of directions; (*c*) vomiting or diarrhea; (*d*) faulty assimilation from physiologic or pathologic influences outside of the gall bladder; (*e*) poor technic.

3. The roentgenologist should know all the facts in every given case, and preferably be in close personal touch with the patient.

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ON THE QUESTION OF PRE- AND POST-OPERATIVE X-RAY TREATMENT OF BREAST CARCINOMA[1]

By MAX KAHN, M.D., Baltimore, Maryland

THE object of this investigation is to study briefly the relation deep X-ray therapy has to the cure of carcinoma of the breast and to the alleviation of symptoms and prolongation of life of patients suffering from it. In our series of 148 cases we have complete records in 109 instances. These records include a carefully taken history; in most instances diagrams of the location of the tumor in the breast; roentgenograms of the chest, spine, and pelvis before and in many cases after operation; the results of study of pathologic specimens after operation, including the axillary glands involved (these we speak of as base, mid-, and apex glands). The records also include a statement as to duration of freedom from symptoms after operation, and, in those patients who have returned with metastasis, roentgenograms of the entire skeleton. In our cases, with few exceptions, we have record of the ultimate result.

We began the treatment of cancer of the breast with deep therapy in December, 1922,

Fig. 1, Case 1. Destruction due to carcinomatous metastases.

Fig. 2, Case 1. Same case as shown in Figure 1. Partial recalcification one year following treatment. Patient symptomatically improved.

—about six years ago—and it is interesting here to compare the results of X-ray treatment combined with surgery with the results obtained before the introduction of deep therapy.

In 1885 the surgeons in this country and abroad were treating cancer of the breast by simple excision of the breast, an operation which, in expert hands, required about thirty minutes. There were no cures by this method. After the introduction by Halsted of what is now termed the complete operation, the operative time was in-

[1]Read before the Radiological Society of North America, at the Fourteenth Annual Meeting, at Chicago, Dec. 3–7, 1928.

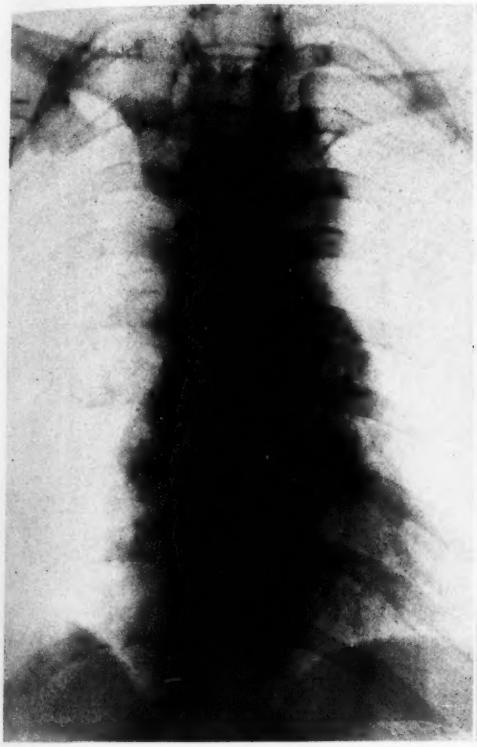

Fig. 3, Case 2. Beginning destruction of body of fifth dorsal vertebra due to carcinomatous metastasis.

Fig. 4, Case 2. Same case as shown in Figure 3, three years following treatment. Vertebra appears healed. Patient clinically well.

creased from a half-hour to three or four hours and the five-year cures came under observation. Large clinics throughout the world report the same results as Bloodgood, that is, in those cases in which the glands are not involved at operation, there are 70 per cent cures; if the base glands are involved, 25 per cent cures; mid-glands, 20 per cent; apex, 10 per cent. The mortality after the Halsted operation at first was 3½ per cent, but after the neck dissection was discontinued the mortality dropped to one-half of 1 per cent. The mortality now has been entirely wiped out, since the skin grafting is done at a second operation. In Halsted's clinic, up to 1900, about 97 out of every 100 breast cases coming under observation were cancer. Of this number, many were inoperable and in the majority of cases the glands were involved. In the last quarter of a century in Bloodgood's clinic fully 50 per cent of the breast cases coming under observation are cases in which operation is not indicated, because of the absence of what we speak of as a definite tumor. Of the remaining 50 per cent, 25 are benign and 25 cancer. In the majority of instances the cancer cases come under observation before involvement of the glands, and the results in these early cases are so good by surgery that we are not using deep therapy as an adjunct.

Our series of 148 cases, of which 129 are from Bloodgood's clinic, consists of those cases in which the glands were extensively involved at the time of operation, and it is this group in which we are now interested. We hope that in the future it will continue

Fig. 5, Case 3. Metastases to spine and pelvis, with bone absorption and destruction.

Fig. 6, Case 4. Partial recalcification two years following treatment. Patient symptomatically improved.

to grow smaller as the patients come earlier. It is the group in which surgery fails to cure more than 10 per cent for five years, and our records show conclusively that so far as a cure is concerned the addition of post-operative X-ray has been of no marked benefit. Nevertheless, we have been able by X-ray alone or by X-ray in combination with colloidal lead to relieve pain and produce recalcification in metastatic bone lesions, and it is in this group of patients, who return with bone metastases, that we see our most favorable results and in some instances prolongation of life. Pain is an indication for X-ray treatment regardless of whether or not metastasis can be demonstrated.

Up to the present we have not had an opportunity to study the effect of pre-operative X-ray treatment in a large series of cases. However, we feel, judging by the few cases studied, that if we are to combine deep therapy with surgery in the treatment of cancer of the breast, the time to begin deep therapy is before operation, particularly in those cases which are clinically late cancer. In a few instances regression of the cancer in well developed cases was noted.

In any study where cure of cancer of the breast is concerned one has to be careful that he is studying only patients who actually have cancer, for benign tumors are sometimes treated by deep radiation and reported as cures. Occasionally a case of this kind is later operated on and proved to be one of the several benign tumors which clinically simulate cancer. The value, therefore, of deep radiation is chiefly after metastasis has taken place; first, for the relief of pain, and, second, in some cases by prolonging life.

Of special importance and interest from the deep therapy standpoint are those cases presenting bone metastasis. The metastasis may be confined to one or more bones or may be very extensive and involve the entire skeleton. In our experience cases with

either single or multiple metastatic bone lesions should all be treated with deep radiation as soon as possible, and while in some cases the response in the single lesions in the relief of pain may not be as rapid as in other cases, a thorough course of treatments should be given. The arrest of destruction and recalcification may not be demonstrable for periods from several months to a year or two. In one case in which the fifth dorsal vertebra was involved and early metastatic changes were found, deep therapy relieved the pain, apparently arrested the beginning destruction, while two years later the vertebra appeared healed and the patient remained free from pain and was clinically well. In some of the cases of extensive metastases in which the pain is excruciating, the patient is unable to walk and has to be carried on a stretcher to the treatment couch, yet the response to radiation may be quite marked. The pain may stop almost immediately or be lessened, the patient may gain weight and feel better as the treatments are administered, and in time she may actually be able to perform her usual household duties. We had one patient of this type who lived three years.

Much, therefore, can be done in some of the most hopeless cases, and, since one cannot tell beforehand which case will and which will not respond to deep radiation, it is advisable to treat all cases having metastatic lesions, as well as those without a demonstrable metastatic lesion in which pain is the chief symptom. Of course, the teeth, sinuses, tonsils or other foci of infection should be excluded before beginning treatment. It is generally advisable to have the patient return at intervals of three months for observation and further treatment.

DISCUSSION

Dr. Joseph Colt Bloodgood (Baltimore): I thank Dr. Kahn for presenting the material that we have had together since December, 1922, now more than six years ago. During the same period I have had an almost equal number of patients, who, because they lived out of Baltimore and near colleagues experienced in radiation treatment, have been treated by others than Dr. Kahn.

We had hoped that routine post-operative radiation might increase that percentage of five-year cures. But when you have a carefully made pathologic examination and include no borderline or benign tumors and know when the glands are involved, the figures as given by Dr. Kahn are unchanged, even if there is pre- and post-operative radiation: 70 per cent five-year cures when there are no metastases about glands; 25 per cent if the base glands are involved; 20 per cent if the mid-glands are involved, and 10 per cent if the high glands are involved. I agree with Dr. Kahn, therefore, that we can find no evidence that radiation in the hands of the most expert has added to the percentage of cures in cancer of the breast. However, it is important that the public and the profession should know and realize that at the present moment radiation—either X-ray or radium, or both—is the only method of treatment that offers any relief at all, if recurrence or metastasis produces pain and discomfort. In the last year or two it has been our rule not to use radiation after operation until there is recurrence, and not to use radiation before operation unless it is a very advanced case locally or the X-ray shows metastasis to bone.

It is also very important to state here that all other methods of treatment of malignant disease of the breast and its metastases have failed to compete in any way with radiation. My personal experience of a hundred cases of intravenous lead treatment fails to convince me that it was at all helpful in conjunction with radiation, or without, so that I have given it up entirely; and with an almost equal experience with tuberculin I could find no evidence to justify its

use. The objection to intravenous lead is that it so increases the anemia that it often inhibits full and repeated radiation. There are many other agents employed throughout the civilized world for the treatment of cancer; these remedies have been used by members of the medical profession and by "quacks"; I can find no evidence of their value. I have records of patients who have been treated by one or more of these "remedies." The hope for comfort in late cancer, recurrent cancer, and metastasis from cancer is radiation. Surgery offers most in the earliest stages; to get a large number of patients with cancer in the earlier stages depends upon a local, continuous, organized, systematic education. The future complete control of cancer rests upon research. At the present moment we are spending too much on attempting to cure the hopeless cancer, and too little on research.

Dr. Albert Soiland (Los Angeles, Calif.): The question of the treatment of cancer of the breast is debatable ground and calls for our most serious consideration. We are all more or less in accord when it comes to the treatment of other parts of the body by radiation, but in the breast there is still a conflict of opinion.

We ourselves have been treating cancer of the breast for two decades with every type of radiation and we are not overly encouraged by the gross results. We have never seen a case of cancer *en cuirasse* healed by radiation or by surgery, although we have a respectable number of primary carcinoma of the breast cases free from symptoms over a five-year period. We have not obtained the results in post-operative treatment of cancer of the breast that had been anticipated. For that reason we feel that in the pre-operative treatment by radiation we may hope to accomplish more, for we have seen enough sporadic work in a pre-operative way to feel sure that this is a more valuable combination of radiation and surgery.

I am glad that Dr. Bloodgood is as charitable to the radiologist as he appears to be to-day. We have had some correspondence which led me to believe that he did not look with much favor upon radiation therapy as a whole. I appreciate his generosity to-day.

ROENTGENOLOGIC RECORDS[1]

By CHARLES G. SUTHERLAND, M.D.
Section on Roentgenology, The Mayo Clinic, ROCHESTER, MINNESOTA

RECORDS concerning roentgenologic data are a source of much concern to individual physicians and to institutions. The development of roentgenology has brought it into intimate relation with almost every branch of medicine and surgery, and much of the technic of the newer methods of diagnosis depends largely on roentgenologic factors. As a result, the internist, the surgeon, and those working in the various specialties are dependent on the roentgenologic records for statistics, for illustration of scientific literature, for lantern slides to be used in lectures and demonstrations, and for original films for teaching purposes.

The progress and end-results of many pathologic conditions can be visualized in series of films or plates made at successive periods. This demands that files be maintained in such a manner that all those of an individual patient are quickly and conveniently available.

Roentgenologic records present two phases: the recording of data and the filing of the films or plates. Both are interdependent and both present problems in administration. A routine of recording data must be established and the degree of success of the whole system depends entirely on the extent to which this routine can be carried.

The size of the record is significant; the daily accumulation of large numbers of sheets soon develops a demand for filing equipment and floor space that materially heightens expense.

Multiplicity of forms and the accumulation of comparatively useless information are factors of expense that cannot be ignored. Overlapping of effort often occurs, particularly in hospitals and in clinics. Departments often record information that is available perhaps in a more convenient form in the department of general records. A brief review of experiences in The Mayo Clinic will serve to elucidate various points.

For many years patients presented the general referring card in use throughout the Clinic to the desk clerk, who made out a record sheet, writing in the registration number, the name, age, and sex of the patient, the name of the referring clinician, the section to which the report was to be returned, and the part of the body to be examined. Six different cards were used, one each for chest, bone, kidney, stomach, gall bladder, and colon. Patients with symptoms referable to the stomach or colon were given a fluoroscopic sheet for the roentgenoscopic examination. This called for desk equipment to hold these various cards and one clerk could not make up more than a hundred records in every two and a half hours. The roentgen-ray report was written on the bottom of the fluoroscopic sheet. This report had to be transcribed to the original referring card. One clerk could not average more than fifty reports an hour so that at least two hours passed before reports were ready for delivery. Another clerk then wrote the registration number, the name, date, and roentgen-ray report on the envelope in which the plates, or films, were to be filed. One clerk could not write more than a hundred envelopes in an hour and a half.

After the roentgenoscopic data concerning the stomach and colon had been compared with the plates, and the roentgen-ray report written in, a new sheet for the digestive tract was made out, which was

[1]Submitted for publication March 22, 1929.

largely a copy of the fluoroscopic sheet, and both were filed.

All the data on the stomach and colon were typed into statistical ledgers, in chronologic sequence, the whole record requiring two pages of 18 by 15¼ inches for every twenty-five entries. The extreme capacity of one binder was 1,500 entries, so that each year from six to ten large statistical ledgers were made up, all of which called for additional floor space.

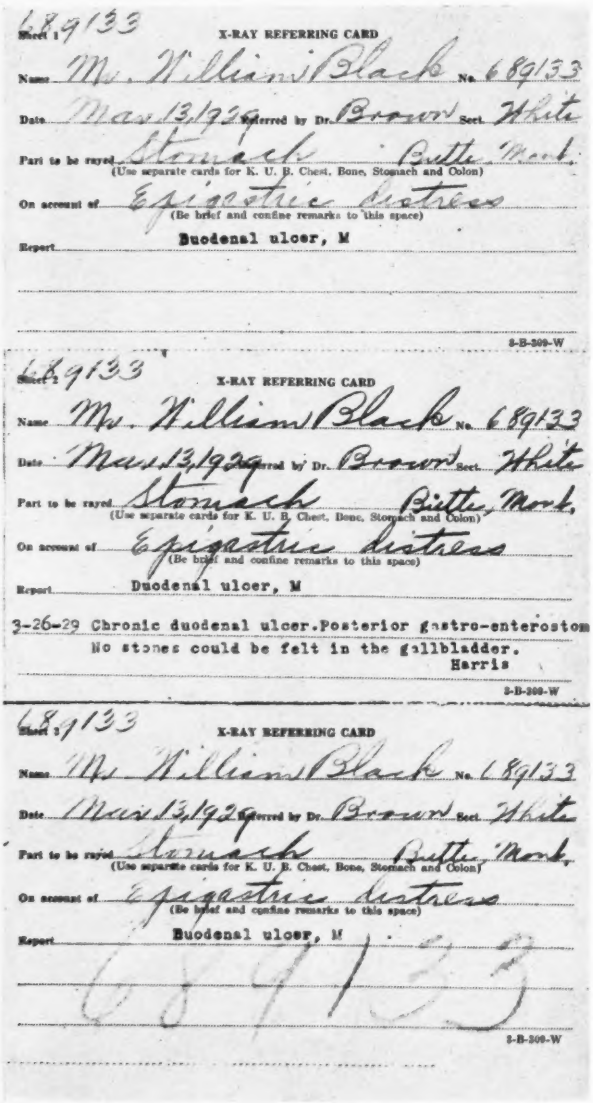
Sheet 1 68133
X-RAY REFERRING CARD
Name Mr. William Black No. 68133
Date Mar 13, 1929 Referred by Dr. Brown Sect. White
Part to be rayed Stomach Butte, Mont.
(Use separate cards for K. U. B. Chest, Bone, Stomach and Colon)
On account of Epigastric distress
(Be brief and confine remarks to this space)
Report Duodenal ulcer, M
3-B-300-W
Sheet 2 68133
X-RAY REFERRING CARD
Name Mr. William Black No. 68133
Date Mar 13, 1929 Referred by Dr. Brown Sect. White
Part to be rayed Stomach Butte, Mont.
(Use separate cards for K. U. B. Chest, Bone, Stomach and Colon)
On account of Epigastric distress
(Be brief and confine remarks to this space)
Report Duodenal ulcer, M
3-26-29 Chronic duodenal ulcer. Posterior gastro-enterostom
No stones could be felt in the gallbladder.
Harris
3-B-300-W
Sheet 3 68133
X-RAY REFERRING CARD
Name Mr. William Black No. 68133
Date Mar 13, 1929 Referred by Dr. Brown Sect. White
Part to be rayed Stomach Butte, Mont.
(Use separate cards for K. U. B. Chest, Bone, Stomach and Colon)
On account of Epigastric distress
(Be brief and confine remarks to this space)
Report Duodenal ulcer, M
68133
3-B-300-W

Fig. 1. Roentgen-ray referring card. Sheets 1 and 2 have carboned backs. The referring clinician writes triplicate copies. Sheet 1 is the report to go back to the clinician. Sheet 2 is the department record. Sheet 3 (with a plain back) is pasted on the envelope in which the films are filed. The large numerals are for convenience in reading the numbers.

Operation has been performed and an abstract of the surgical findings has been typed on the department record sheet.

The department record sheets were filed in drawers, five to a cabinet, each cabinet measuring 14 by 28 by 52 inches. By 1922 these cabinets were occupying 82 square feet of floor space and increasing at the rate of 15 square feet annually. Further expansion was impossible and the reduction of old files and elimination of future demands was taken into consideration, and the following plan organized.

THE ASSEMBLING OF DATA

Every patient, on registration, receives a registration number and this number is used on all the records of the patient throughout the Clinic. If a patient returns for subsequent examination or treatment, registration is under the old number, the old history is called from file, and the new notes are added. The Clinic registration number is used on all the roentgen-ray records.

The regular referring card used throughout the Clinic is 3 by 5 inches, and all the office equipment and envelopes are made to conform to this size (Fig. 1).

A sheet of thin, tough paper, 9 by 5 inches, is carboned on one side over a 3-inch depth at each end. Three equal portions are printed in such a manner that they can be folded to produce a triplicate copy of the same report. The portions are numbered 1, 2, and 3, the two ends folding over the central portion, the back of the latter not being carboned.

The clinician uses a hard pencil or a stiff pen in writing a referring card and makes three copies. Number 1 is the report which will come back to him after the roentgenologic examination, Number 2 is the department record sheet, and Number 3 is the label for the envelope in which the films are to be filed.

As the patient presents this card in the Section on Roentgenology the desk clerk has only to ask for the registration card, write the registration number in the upper left hand corner of the card to check that written in the right hand corner by the referring clinician, make up the film marker, and send the patient to the technician. All clerical work at the desk is therefore eliminated.

The film marker is a strip of adhesive tape (3 by 2 inches) on the upper margin of which the date is placed in 2/8 inch lead numerals and along the bottom margin the registration number in 3/8 inch lead numerals. The technicians carry their own initials in lead letters fixed on a small strip of aluminum by adhesive and place this between the date and the registration number. All records are kept in numerical sequence and are known only by the registration number.

The technicians, when the films are made, put the cards in especially devised racks which superimpose the registration numbers, allowing them to be seen quickly. Separate racks are kept for cards of chest, bone, kidney, stomach, colon, and gall bladder. When the films are ready for sorting, these racks are taken to the plate room, where the corresponding referring card is placed on top of the films ready for reading.

The consultant reads the card, passes it to the stenographer, dictates the report, and piles the films in a special compartment on the stenographer's desk. The report is typewritten from dictation and the card is then torn into three parts along the perforated lines. Numbers 1 and 2 are placed in separate piles and Number 3 is placed on top of the films. The Number 3 card is pasted on a large envelope, and the registration number is written in large numerals with a soft blue pencil, to make it more easily visible in the file. The films are checked with the registration number, and then placed in envelopes. The envelopes are sorted in numerical sequence and are ready for filing.

The Number 1 cards are sorted into compartments, which are labelled for the various clinicians to which they are to go, and are ready for delivery.

THE DEPARTMENT RECORD

The Daybook.—The Number 2 cards are divided into groups, the negative data in one and the positive in the other. All are counted after having been subdivided into six groups each, chest, kidney, bone, stomach, colon, and gall bladder. The daily count thus subdivided is kept in a book ruled accordingly. In the annual report this count is tabulated, showing the total volume of work in months and for the year.

The Ledger.—The data on the Number 2 cards are then recorded in an especially devised ledger which brings all the records into numerical sequence as a routine, affording a permanent note of each and a ready reference as to whether any patient had any given examination. The Number 2 cards are placed in trays according to the six groups of data after record is made in the ledger. The disposition of these cards will be described later in the paper.

The ledger is made up in two volumes for each year, for convenience, the one recording the data from roentgenograms of chest, bone, and kidney, the other those from roentgenograms of stomach, gall bladder, and colon (Figs. 2 and 3). The two sides of each sheet in the ledger serve for the recording of data for 1,000 registration numbers. With a rubber stamp, in 3/8 inch numerals, each sheet is numbered in sequence of thousands, starting with the

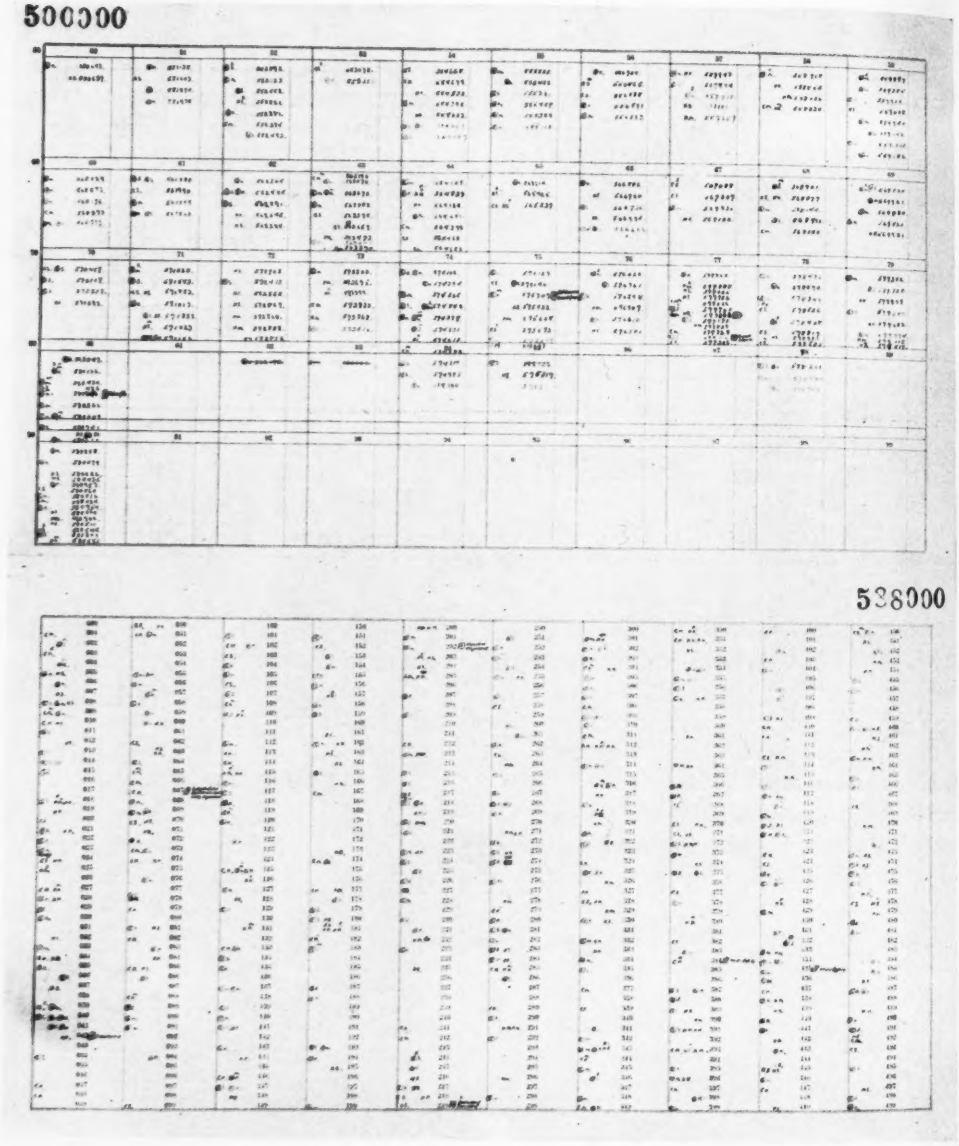

Fig. 2. Two types of ruled sheets used in the recording ledgers. The sheet ruled into fifty squares on each side is used to record registration numbers below those of the current year and brings them into nearly numerical sequence. The entries from these sheets are transferred at the end of each current year to their regular sequence in the ledger and an entry to the right of the numeral notes the year in which the examination was made.

The other sheet is numbered from 000 to 499 on one side and from 500 to 999 on the other. One sheet is carried in the ledger for every 1,000 registration numbers.

current registration number of the year (the sheets would be numbered, for example, 650,000, 651,000, 652,000, and so on). The sheets are 18 by 10½ inches, ruled into ten columns on each side of the sheet, and each column subdivided into five spaces. In the fourth space of each column numerals in sequence from 000 to 499 (50 in each col-

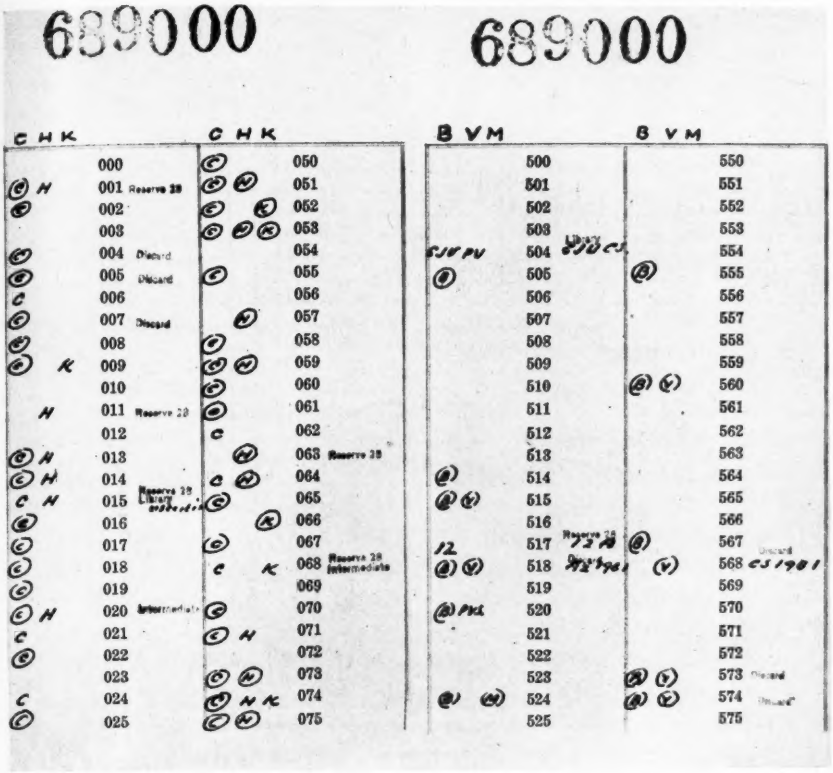

Fig. 3. A detail of Figure 1. Sections of the recording ledgers. Two series of ledgers are used, one recording the findings in chest, bone, and kidney, the other stomach, gall bladder, and colon.

The code letters designate the columns for (C) chest, (H) bone, (K) kidney, (B) stomach, (V) gall bladder, and (M) colon. A code letter in red ink without a circle indicates a positive finding; one in black ink with a circle around it, a negative finding.

The space to the right of the numeral is used to record the surgical findings (if any), and with a rubber stamp all lantern slides, reductions, library films, or discards are recorded against the entry indicated. When films are sent to reserve file this can be indicated by a rubber stamp notation. This affords one central record of all information regarding any individual film.

Detailed information of positive findings is available in the loose-leaf books into which positive findings are copied.

umn) on one side and 500 to 999 on the other are printed. On the left of the numeral three ¼ inch spaces are ruled (for recording of roentgenologic data in a code form) and one ⅜ inch space on the right (for the recording of surgical, clinical, or necropsy data).

The records of patients who have registered in former years and have returned are temporarily recorded in the front of the ledger for the current year. Founded on the probability that not more than nine patients of each thousand who have registered in former years will return and a roentgenologic examination be made, each side of the sheet is divided into squares of nine lines, each square providing for entries within 1,000 registration numbers.[2] If it happens that more than nine patients in a given group of 1,000 should reregister, and require roentgenologic examination, another sheet is easily inserted in the ledger. All

[2]There are 50 such squares on each side of the sheet, and thus each sheet provides for the entrance of data within 100,000 registration numbers.

the entries for cases in which registration took place prior to the current year are thus brought into nearly numerical sequence; at the end of the year the data are recorded in their respective volumes of the ledger in exact numerical sequence, and a note is made after the numeral to signify the year in which the examination is made.

Volumes of the ledger have been made up for all the records which were made before the present system was started. For numbers below 10,000 the sheets similar to the one used in the front of the current year ledger were sufficient to bring all into a nearly numerical sequence. From 10,000 to the last registration number a sheet was provided for every 1,000 numbers, as described.

For the recording of roentgenologic data code letters are assigned to each group. A definite space at the left of the numeral is assigned to chest, bone, and kidney in one volume, and stomach, gall bladder, and colon in the other. A code letter in red ink in any column indicates positive data, one in black ink with a ring around it negative data. The circle is added to give more definition to negative data and lessen the possibility of error in recording.

In the recording of the surgical reports on the stomach, gall bladder, and colon in the ledger code letters and numerals are used to designate the lesions. (See Table I.) The surgical books of the various hospitals, in which the dictated notes on the operation and surgical data are written up, are kept in chronologic sequence. Every day these books are checked against the roentgenologic ledger and when any abdominal operations have been performed the data are recorded in code, in red ink, in the column to the right of the numeral, against all entries concerned. The roentgenologic report and the surgical data are thus brought together and checked as a routine.

At the time the surgical data are recorded in the ledger a note is made of all numbers and the Number 2 cards are drawn from file and an abstract of the operation and the surgical data are typed across the face of the card in red. The fluoroscopic sheet, which is the only record that is preserved in its original form, is drawn from file at the same time and by resting the Number 2

TABLE I

CODE LETTERS AND NUMERALS USED IN RECORDING ROENTGEN-RAY FINDINGS OF THE GASTRO-INTESTINAL TRACT

A esophagus	*I* duodenum	*Q* transverse colon
B stomach	*J* jejunum	*R* splenic flexure
C cardia	*K* ileum	*S* descending colon
D media	*L* ileo-cecal valve	*T* sigmoid flexure
E pars pylorica	*M* colon	*U* rectum
F pylorus	*N* cecum	*V* gall bladder
G greater curvature	*O* ascending colon	
H lesser curvature	*P* hepatic flexure	
1 abscess	*14* hour-glass	*27* stasis
2 adhesion	*15* incompetence	*28* stenosis
3 anomaly	*16* indeterminate	*29* stricture
4 atony	*17* Jackson's membrane	*30* syphilis
5 cancer	*18* kink	*31* transposition
6 dilatation	*19* negative	*32* tuberculosis
7 displacement	*20* non-rotation	*33* tumor
8 diverticulum	*21* normal	*34* ulcer
9 enteroptosis	*22* obstruction	*35* cardiospasm
10 fistula	*23* ptosis	*36* gallstones
11 foreign body	*24* redundancy	*37* filling defect
12 hernia of the diaphragm	*25* spasm	*38* diverticulitis
13 Hirschsprung's disease	*26* spasticity	*39* chronic ulcerative colitis

card over the space on the fluoroscopic sheet designated "operative findings" this information is duplicated on the fluoroscopic sheet through the carbon back of the Number 2 card. If a patient should return for subsequent examination the fluoroscopic sheet is taken from file and goes with the patient to the roentgenoscopic examining room, affording the consultant all information as to former examinations, surgical procedure, and operative data.

At the end of a year the complete records of the stomach, gall bladder, and colon are in numerical sequence, completely checked and comprehensively described by legends. These data have only to be charted in order to afford a perfect analysis of the year's work from any phase.

Disposition of Number 2 Cards.—After record is made in the ledger, the Number 2 cards are filed in drawers of two compartments, the positive data on the left, the negative on the right. The grouping into chest, bone, kidney, stomach, gall bladder, and colon is maintained in the filing to afford convenience in the statistical study of any given group. At the end of the year the records of negative data are transferred and kept in trays for the second year. At the end of the second year they are discarded, the record in the ledger being considered sufficient after this period.

The keeping of the records of positive data in file after the end of the year required the addition of at least two cabinets of filing drawers annually and would entail a great deal of filing in, which is time-consuming, so it was found expedient to copy the registration number, the name of the patient, and the roentgenologic report on loose leaves, an average of 100 records to a page, and to arrange these leaves in books. To correspond with the arrangement of the ledgers one book is made of chest, bone, and kidney reports and the other of stomach, gall bladder, and colon.

With the positive data of chest, bone, and kidney recorded in loose-leaf books it is possible to check the entries against the histories in general file and make notations of the clinical, surgical, or necropsy data. All records that would indicate further clinical, scientific, or teaching interest are marked *X* and incidental data or conditions that would not suggest further interest after the patient had left the Clinic are variously marked. A clerk, taking this book, indexes and cross-indexes all the former, affording at once a ready reference to all lesions of interest for seminars and investigations in general. The latter markings are useful in the ultimate disposal of the films, which will be described later.

The file is 4½ feet in height, which is convenient. Resting on top of the cabinets is a double tier of shelves, each 13 inches in height. On the lower shelf are the loose-leaf books containing the data of the various years. On the upper shelf the ledgers are kept, running from 10,000 to the last registration number in numerical sequence. On the top of the shelf above the ledgers rest the trays containing the negative records for the preceding year. The whole does not exceed a height of 8 feet and all books and records that are in more or less current use are easily reached by any one of usual stature.

This arrangement made it possible, in the planning of a new department, to assign a floor space of 15 square feet to records with an assurance that this would not require expansion for a considerable period.

The five cabinets of filing drawers, a total of fifty drawers, are ample for the records of the current year and the keeping of those of the preceding year in order until they have been transferred to loose-leaf books.

THE FILING OF FILMS AND PLATES

Films are filed in envelopes, with the Number 3 card pasted on the upper right

hand corner, as described. Those in which the data are negative are filed in separate sections and are discarded after thirty days. To avoid all filing in or checking, two sections are used, filing in one for the first month and in the second one for the second month. On the last day of each month the older file is discarded, leaving it ready for the new month. In this manner all films are kept the full thirty days and the discarding is entirely automatic. All envelopes holding negative films have a broad yellow band printed across the right front end. All filing is in numerical sequence.

Films showing positive data are filed in plain envelopes, and labelled as described. All films are filed in a vault built into the main plate room. Provision has been made for the complete file of one year's positive films in this room. On the last day of the year this file is transferred to a vault in the basement of the Clinic building, where it is filed in one section. During the year the positive data are checked, as described, and this checking has demonstrated that approximately 60 per cent of the films will not be of further interest after the patient has left the Clinic. With the index as a guide the remainder may be used during the year as seminar material, in group studies, and so forth. Many are sent for lantern slides, for illustrations for scientific papers, and some are selected for segregation in the roentgenologic film library. In all such cases the label on the envelope is stamped with the word "reserve" in half-inch letters to indicate that it has been investigated.

The films are kept in the Clinic building, each year in a separate section, as long as space permits; then, with the loose-leaf book as a guide, the file clerks remove all those marked for reserve files. The clerk holding the loose-leaf book and calling the numbers can stamp each one as called with a small rubber stamp to indicate the year of the reserve file into which the films are going. The films can be stacked on especially devised trucks in perfect numerical sequence and transferred to a warehouse on the grounds of the experimental institute, outside the city limits and at least 500 feet from any other building, where each year's films can be kept in a separate section, as long as space will permit. Taking the loose-leaf book, the record clerk can stamp the record of this transfer in the space to the right of the numeral in the department ledger, thus affording accurate information as to the situation of every film in both the loose-leaf book and the ledger.

When a film is sent for reduction a note of this is stamped with a rubber stamp in the department record ledger; if a lantern slide is made, a note of it is stamped in the same manner. Before a film is sent for reduction or for a lantern slide it is checked against the ledger to avoid duplication in any of the processes. After a reduction has been made every film is stamped in the photographic section as an additional guard against duplication.

The segregation of groups of interesting material as a routine has been carried out throughout the Clinic by reproduction in lantern slide form. This calls for a reduction to a 5 by 7 inch film and a reproduction of this again to make the lantern slide. Only a limited number of these is ever used for any other purpose than study.

In accumulating films for the library, except films of chests and a limited number of others, it has been found feasible to cut the original film to fit a standard size cardboard mount and thus still retain all the essential features. The pieces of cardboard on each side are of sufficient thickness to prevent scratching as the films are piled together. The film is fixed on the rear mount with a metal fastener, the front mat is laid over the film and the two are bound together by an aluminum strip that overlaps each end and side for a distance of ⅛ inch. An

8 by 10 inch mount is used with two sizes of aperture, 8 by 7 inches for the majority and 6½ by 7 inches for the remainder. The corners of the mount are rounded; the side binding strip is 9½ inches and the end binding strip 7¼ inches. The rounded corner with the binding reaching only to the end of the straight edge simplifies the binding and has other advantages in handling the films in the filing drawers.

The library film, the result of suggestions and experiments by the personnel of the photographic section and surgical instrument shop, is inexpensive as compared to lantern slides, light in weight (less than 10 pounds for each 100), cannot warp, with ordinary care is almost indestructible, and cannot be scratched. The detail is preserved so that for small groups this film is superior to the reproduction or lantern slide for teaching purposes.

If overloading of any group requires it, the whole film can be dismantled and practically all the material used over again.

The lower margin of the mount is left a minimum of 1 inch wide and a printed legend 5½ by ¾ inches is pasted on. If desired, an abstract of the history can be printed in small type and pasted on the reverse side of the lower margin, where a space 7½ by ¾ inches is available for this purpose.

These library films, filed in steel drawers and divided into groups by guide cards according to pathologic or other data, solve entirely the problem of segregation of interesting material.

Whenever a film is taken from the regular file for the library a note of this is stamped (with a small rubber stamp) in the department ledger and the group noted after it, for example, "280,932 library (sarcoma knee)," makes it as easily available as it would be in the file.

In the case of films of chests or other films too large to use in the original, a reduction is made and from this a reproduction on an 8 by 10 film is made for mounting.

SUMMARY

A triplicate copy roentgen-ray referring card has been designed which will obviate all clerical duties at the reception desks. The same card eliminates six different printed forms and reduces the department record to one-quarter the size. This allows four times the filing capacity and also the grouping of data in the files. The positive data of any one of six groups can be carried in a light tray, 12 by 24 by 4 inches, to any desk for review.

A ledger has been devised which records all the data by a single code character and brings them into numerical sequence as a routine. All other data, clinical, surgical, or postmortem, checked against the entries in this ledger, are similarly brought into sequence.

In recording the results of examination of the stomach and colon the size of the statistical ledgers are reduced thirty times. An abstract of the surgical observations typed on the department record sheet provides, as a routine, a daily check arranged in sequence of all the cases in which operation was performed, a convenient form for review. With this system all the data with regard to the stomach, gall bladder, and colon for a year have been charted in less than a week from the end of the year, with a complete check of the surgical data in all cases in which operation has been performed.

Recording the data on the old record sheets filed in the ledgers, and copying the reports into loose-leaf books eliminated thirty filing cabinets of five drawers each, reduced the floor space occupied from 82 square feet to 15 square feet, and obviated an annual demand for an additional 15 square feet.

By a series of rubber stamps all the reductions, lantern slides, and library films are recorded in the ledger, thus establishing one central register of these and eliminating all others. By checking all films and plates against the ledger before sending for reductions or lantern slides, duplication can be avoided.

Copying the positive data into loose-leaf books reduces the essential information of the department record file to less than 1 cubic foot in volume for each 100,000 records. In numerical sequence, these books can be checked rapidly against the histories in the general file and an index of "proved" cases can be estab'ished. In the investigation of any group this saves the time of the professional staff and much effort in reviewing non-essential records, and widens the scope of the department from the educational viewpoint.

The loose-leaf books afford an easy and accurate method of arranging the film files so that the non-essential films are segregated and the essential films are retained in a convenient situation for the maximal period. This avoids considerable waste of time of the record clerks in hunting out the films of patients who have returned or groups of films requested for study or other investigation.

Using the same books as a guide, the department record clerks can quickly and easily record in the ledgers the site of every film or plate. All lists of films or plates requested for study can be checked against the ledgers and marked so that time is not lost by the record clerks in getting these out.

In the library films the segregation of interesting material has been accomplished without disarranging the other files. The library films afford a quick and accurate method of assembling material for seminars and lectures, for the writing or illustration of scientific papers, and of choosing suitable subjects for lantern slides. Conveniently situated and arranged, these films can be reviewed by the graduate student, the members of the permanent staff, and by visiting members of the profession. They also provide a method by which requests for exhibits of roentgenologic subjects for national, state and other society meetings can be met without undue expenditure of time, effort, and money.

This recording and filing system is accurate and yet simple and I believe it is sufficient for all ordinary demands. One central register contains all the information on the individual film or plate. The use of this system has reduced the cost of paper, printing, binders, and files more than 85 per cent, and the time of the clerks devoted to records more than 70 per cent. This, with the reduction of floor space, and the elimination of an annual demand for increased floor space, has been a real factor in the reduction of operating costs in the department. It has saved the time of the staff members and has materially enhanced opportunities for acquiring knowledge. It has heightened the accuracy of statistics and, since it affords a complete check on all phases of the work, has stimulated individual effort toward increased efficiency and accuracy.

Experience in The Mayo Clinic would suggest that this system has features to recommend it to all who have been confronted with similar problems in departmental administration.

EFFECT OF ROENTGEN RADIATION ON CERTAIN CHEMICAL COMPOUNDS: (*A*) TYROSINE AND CYSTINE; (*B*) CHOLESTEROL; (*C*) ACETYLENE AND PROPANE[1]

By WILHELM STENSTROM, PH.D., MINNEAPOLIS
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THE effects of roentgen rays on several kinds of chemical compounds in solution have been studied by different investigators. As a rule, it has not been determined exactly what kind of reactions were produced, but definite changes took place in most of the compounds reported upon. The quantitative relations between the dose and the change produced can be classed in four different groups: (1) no measurable (or appreciable) effect; (2) the change follows the mass action law; (3) the change is directly proportional to the dose given, and (4) no simple relation between the dose and the change is found. To the first group belong solutions of cholesterol in benzene (1); to the second group, trypsin (2) and hemoglobin (3) in weak aqueous solutions; to the third group, aqueous solutions of ferrosulphate with some sulphuric acid (4), and to the fourth group, solutions of cholesterol in chloroform (5).

In order to find out more about the laws governing the reactions that take place when chemical compounds are exposed to roentgen rays, we have started a series of experiments in our laboratories. For these experiments we utilize the radiation from a water-cooled high voltage Coolidge tube while patients are being treated. The solutions and gases used, so far, have been sealed in glass tubes and these placed inside the "Acme International" tube stand in which the roentgen-ray tube is installed. The distance from the target to the center of the tubes was 57 cm.; 180 to 200 K.V. and 30 ma. were used. The solutions were sealed in glass tubes about 15 cm. long and 1.5 cm. in diameter, with a content of about 15 c.c. of the solution. Usually two tubes were placed together; one inside a lead container with 3 mm. thick wall which prevented any appreciable amount of radiation from reaching the solution used as control, and the other inside an aluminum container of 0.3 mm. wall. Thus only a small amount of the roentgen radiation was stopped by the aluminum, while visible radiation was excluded and the temperature kept equal to that of the other tube. The filter consisted only of this aluminum and the glass wall which was about 1.5 mm. thick. Anne Lohmann co-operated in the experiments with the solutions. They will be reported in more detail elsewhere (6).

In order to find out to what dose the solution was exposed on an average per hour, we radiated 0.001 molar ferrosulphate in a 0.8 N sulphuric acid solution. According to Fricke and Morse (4), 50 per cent of the ferrosulphate in such a solution is oxidized to ferrisulphate by a dose of 28.35 k.r. (kilo roentgen). Table I gives the results obtained when the solution was irradiated with different amounts of roentgen rays. The values obtained indicate that less was oxidized per hour the longer the solution was exposed (Column 3, Table I). The measurements are, however, too few and the experimental errors too large to permit a definite conclusion, especially as the measurements were made on different days. The values were plotted on a chart and a straight line drawn by inspection. In this way a change of 13.9 per cent per hour was obtained, which corresponds to a dose of 7.9

[1]Read before the Radiological Society of North America, at the Fourteenth Annual Meeting, at Chicago, Dec. 3–7, 1928.

k.r. per hour. Thus, the solution received a dose of 7.9 k.r. per hour of radiation with 200 K.V. and 30 ma.

We have also used this method to determine our erythema dose in r-units. The ferrosulphate solution was poured into a 1 cm. deep, 15 cm. long, and 10 cm. wide cavity in a paraffin block and was covered with a piece of paper coated with paraffin. According to the measurement, one erythema is equal to about 1100 r-units.

TABLE I

Ferrosulphate 0.001 N $FeSO_4$ in 0.8 N H_2SO_4

Time of exposure	Oxidized	Oxidized per hour
Minutes	Per cent	Per cent
32	9.2	17.3
60	16.0	16.0
121	30.0	14.9
168	37.5	13.5
240	56.0	14.0
331	69.0	12.1

It seemed of interest from a biological point of view to find out what influence the radiation would have on amino acids. Tyrosine was irradiated in three different concentrations corresponding to 1 mg. per c.c., 0.1 mg. per c.c., and 0.02 mg. per c.c., respectively. Sulphuric acid was added to the solutions in order to prevent fermentation. The first two solutions were made 2 N and the third 0.04 N in respect to sulphuric acid. The method of Folin and Ciocalteu (7) was used to measure the amount of tyrosine changed in regard to the phenol group by the radiation. The combined errors of the dosage and the measurements amount to about 10 per cent. It is larger for the smallest and largest values obtained. The results are given in Table II.

TABLE II

	Time of exposure	Changed	Changed per hour
		Per cent	Per cent
Tyrosine A			
1 mg. in 1 c.c. 2 N			
H_2SO_4 (0.1% sol.)	27 hrs.	2	0.074
	156 "	14	0.090
Tyrosine B, C, and D			
0.1 mg. in 1 c.c. 2 N			
H_2SO_4 (0.01% sol.)	10 hrs. 30 min.	5	0.48
	11 " 56 "	10	.84
	18 " 12 "	11	.61
	23 " 5 "	14	.61
	26 " 50 "	17	.63
	28 " 32 "	18	.63
	30 " 25 "	20	.65
	34 " 25 "	24	.70
	43 " 12 "	26	.60
Tyrosine E			
0.02 mg. in 1 c.c.			
0.04 N H_2SO_4			
(0.002% sol.)	4 hrs. 8 min.	8	1.93
	6 " 13 "	13	2.09
	7 " 58 "	16	2.02
	10 " 31 "	23	2.18
	11 " 49 "	25	2.11

Within the limits of the errors, the percentage changed by the radiation is directly proportional to the dose for each concentration. The total amount of tyrosine changed does not vary much with the concentration. When the solution was diluted fifty times, about one-half as much tyrosine was changed. Tyrosine in weak sulphuric acid solutions, therefore, belongs to Group 3. It seems as if the ionized (or excited) water molecules produced by the radiation are responsible for the change of the tyrosine molecules. The reaction produced in gases by radiation with α-rays is, according to S. C. Lind, probably caused by the ions and not by the "excited" molecules. The number of excited molecules in air has not been measured. It does not seem reasonable to assume that the number of excited molecules in water should be proportional to the pair of ions produced in air. If about the same number of molecules are ionized per gram of solution as are ionized per gram of air by the roentgen rays, it would take on an average about twelve pairs of these ions to remove one phenol group from the most dilute solution, and six pairs of ions in the most concentrated solution. It is possible that other phenols are formed during the irradiation, *e.g.*, poly-phenols. As we are measuring only the difference between the original and the final color reaction of the phenol groups a considerably greater percentage of the tyrosine may be destroyed than is represented by our figures. In the ferrosulphate solution about five ferrosulphate molecules

would be changed by each pair of ions. The relation between the number of phenol groups removed and the number of ferro ions oxidized is 1 to 60 and 1 to 30, respectively. The tyrosine solutions become colored slightly yellow or brown when irradiated, and the greater the roentgen dose the stronger the color. We have also determined the change in a pure tyrosine solution without any sulphuric acid. The same amount of tyrosine was changed in this solution per k.r. as in the sulphuric acid solution of the same tyrosine concentration. The sulphuric acid evidently has no appreciable influence on the rate of the change. It is possible that the type of changes described above takes place in the human body when the patient is exposed to roentgen rays. One erythema dose over a large field could change a considerable amount of such organic compounds.

Cystine was irradiated in the same way as tyrosine. One hundred milligrams of cystine was dissolved in 100 c.c. of a 1 N aqueous solution of sulphuric acid. This solution was irradiated for 95 hours; no change of the cystine could, however, be detected by means of the Folin-Denis uric acid reagent (8). The same result was obtained when the solution was diluted ten times with 1 N sulphuric acid and irradiated for 35 hours and 15 minutes. The solution was not discolored by the radiation.

The change of the phenol group in tyrosine indicated that phenol itself ought to be influenced by the radiation. Experiments similar to those described for tyrosine showed that phenol in a weak aqueous solution was changed in a similar way.

It was mentioned that cholesterol in chloroform solution belongs to Group 4. That means that it has to be studied a great deal before we can say much about the mechanism of the reaction. The finding by Reinhard that the same amount of change was produced whether the radiation was filtered with 0.5 mm. copper or unfiltered (the other factors being the same), was quite startling and called for further study. We therefore exposed three tubes of a solution of cholesterol in chloroform side by side; one tube in an aluminum container with 0.3 mm. wall, one inside a brass container with 0.8 mm. wall, and one in a brass container with 3 mm. wall. We used the same colorimetric method as Reinhard for the cholesterol determination, and in one experiment also the same concentration (0.45 per cent). The results are given in Table III.

TABLE III

PER CENT CHOLESTEROL CHANGED

Solution A—0.45% cholesterol in chloroform irradiated 27.93 hrs.
Solution B—0.60% cholesterol in chloroform irradiated 31.63 hrs.

Filter	Change in A	Change in B
0.3 mm. Al. + glass	34	24
0.8 mm. brass + "	9	8
3.0 mm. " + "	2	2

The largest and the smallest figures (34 and 2) are uncertain, but the results show clearly that the heavier the filter, the smaller the change. This is not in agreement with Reinhard's findings. Our second filter was unfortunately a little heavier than that used by Reinhard (0.5 mm. copper).

We have recently repeated this experiment, using a 0.45 per cent solution and filters of 0.3 and 3.0 mm. aluminum, 0.5 mm. copper, 0.8 and 3 mm. brass. Similar results were obtained. The heavier the filter, the smaller the change of cholesterol. In all these experiments we used cholesterol obtained from the Eastman Kodak Company.

It is evident that the solvent is of importance for the reaction and that the activated molecules of some solvents are not able to change the cholesterol in the state it is present. We radiated a solution of 0.15 gm. in 100 c.c. benzene for 131 hours (an exposure equal to about 1,000 k. r.). Even after this large dose, no change was discovered.

It was interesting to find that ethylene chloride, when exposed to roentgen rays, gave a positive reaction with the chlorine ion test just as chloroform did. Bachem's (1) assumption that the chlorine ion is essential for the reaction is, however, contradicted by Reinhard and Buchwald's finding that cholesterol in an absolute alcohol solution is also changed by roentgen radiation (9).

The assumption that the chemical reactions caused by radiation are proportional to the ionization also implies that the same change should be produced by different kinds of radiation as long as the same amount of ionization is effected. Thus changes brought about by α-rays from radium should also be produced by roentgen rays if only the dose is large enough. A polymerization of acetylene is caused by α-rays and Lind (10) has found that 20 molecules of acetylene disappear from the gas for each pair of ions produced. If the same relation holds for roentgen radiation, a very large dose would be required to get a measurable effect. A glass tube with acetylene at a little above atmospheric pressure was irradiated for 145 hours and the gas was afterwards analyzed by Dr. Glockler. An estimation gave that about 1 per cent of the acetylene should have disappeared according to the theory. The error of the measurements amounted, however, to about 1 per cent. No significant change was found.

SUMMARY

Chemical changes are produced when certain chemical compounds in solutions are irradiated with roentgen rays.

The average dose per hour of radiation has been determined by the oxidation of ferrosulphate in a weak sulphuric acid solution.

It was found that tyrosine in a weak aqueous or sulphuric acid solution was changed with regard to the phenol group, by roentgen radiation. The quantitative relation has been determined.

Some experiments have been carried out with cholesterol and compared with results obtained by other investigators.

Acetylene and propane in gaseous state have been irradiated for 145 hours. It was found that much larger doses are required to permit definite conclusions.

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DISCUSSION

Dr. Otto Glasser (Cleveland): I feel that Dr. Stenstrom's investigations are of great importance and I wonder whether we can really appreciate their value at the present time. The experiments for the purpose of determining the influence of radiation upon chemical reactions are a step in the direction of the study of the physics of the cell. For many years chemicals have been observed to change under the influence of X-rays, but the investigations made in this direction within the last few years by Stenstrom, Fricke, Morse and others are especially valuable because in them these reactions have been connected with other physical reactions of radiation which are well under control.

I am not able to discuss Dr. Stenstrom's

findings from a physical-chemical point of view since I do not know enough about the actual chemistry of the reactions produced, but we might look at the problem from an angle which particularly interests us here. About ten years ago my former chief, Prof. Friedrich, started some experiments with ortho-nitro-benzaldehyde in order to study the influence of the addition of materials of higher atomic weight to solutions of this chemical, comparing the effect of radiation upon the unaltered solution with the influence of the radiation upon the solution after the addition of these materials. At that time, however, the changes produced in the chemicals by radiation with the experimental means at hand were so small that they were practically within the range of experimental error. But yesterday, for example, we heard from Dr. Wood that if he radiates the eggs of the fruit fly on a paraffin block, he has to bring the eggs into physical contact with the paraffin in order to register accurately the back-scattering from the paraffin. What does that mean? It means that there must be a radiation component created in the thin layer of water which makes the physical contact between egg and paraffin that is not present when the water is missing. Such a component, then, would naturally be so soft that we can not expect it to penetrate the walls of an ionization chamber. In other words, in our routine measurements of back-scattering it would not be registered. If, however, we have chemicals of the kind mentioned by Dr. Stenstrom, or perhaps others, there is a chance that we can work out accurately Prof. Friedrich's old idea, since we are certainly able to register changes which any radiation, however soft it might be, must have upon the molecule. I feel that Dr. Stenstrom's experiments, together with Dr. Wood's suggestions, point in this direction and present problems for us to work out in the next few years that will perhaps bring us much farther toward our final aim, that is, the study of the physics of the action of radiation upon the cell.

DR. H. J. ULLMANN (Santa Barbara, Calif.): I would like to ask Dr. Stenstrom if he has any data that would show the number of milligrams of ferrosulphate that is changed to ferrisulphate per unit of radiation.

I believe, as Dr. Glasser has said, that this work is going to open a new line of attack on the problem of measuring dosage, not from the physicist's standpoint but from that of the everyday user, the clinician.

DR. STENSTROM (closing): In answer to Dr. Ullmann's question, I want to say that Hugo Fricke and Sterne Morse published those data in the *American Journal of Roentgenology and Radium Therapy* in 1927. They gave them there in milligrams, so many milligrams per so many r-units.

I appreciate very much Dr. Glasser's fine discussion of the paper. I wanted to point out that though these experiments were not made in order to find some method of measuring roentgen units, I think that measurements of this kind will lead to a simple method for standardizing roentgen machines which can be used by most men.

Fricke has already stated that ferrosulphate can be used for that purpose and we have used it for that purpose, but it requires fairly delicate instruments.

Our measurements show that the colorimetric change that was produced after the radiation of tyrosine is directly proportional to the amount of radiation. This colorimetric measurement is very simple. However, you noticed, perhaps, that these solutions had to be radiated for quite a long time—an inconveniently long time.

I would be very much surprised if we should not find some similar changes that would be effected by much smaller doses, so that it would require a short exposure to produce an appreciable change which could

be measured easily. Then some such method could be used to standardize X-ray machines and to ascertain more about the action of radiation.

Rhinolith, Requiring External Nasal Operation for its Removal. M. C. Myerson. Laryngoscope, June, 1928, XXXVIII, 393.

The author reports a case of a male, aged 69, complaining of obstruction to the right side of the nose and of excessive tearing from the right eye. Symptoms had been present for the last four years. During this time there had been a definite discharge with a foul odor from this side of the nose, with a gradually increasing obstruction. Examination revealed a polyp which obstructed the right side of the nose. The left side of the nose was obstructed by the displacement of the septum to that side. X-ray examination revealed involvement of the right frontal, ethmoid, and maxillary sinuses, the left maxillary sinus, as well as a dense irregular shadow which appeared to be either a rhinolith or a bony mass. Under local anesthesia the right nasal chamber was exposed and a large irregular stone was found firmly wedged between the septum and the lateral wall. The stone at the time of removal was 4 centimeters by 2½ centimeters in its greatest diameters and weighed 56 grams. It consisted chiefly of calcium carbonate, calcium phosphate, and calcium oxalate. The patient was discharged as recovered twelve days after operation.

B. C. Cushway, M.D.

TREATMENT OF MALIGNANT TUMORS OF THE RECTUM BY RADIUM AND ROENTGEN RAYS[1]

By HARRY H. BOWING, M.D., ROBERT E. FRICKE, M.D., Section of Radium Therapy, and NEWTON D. SMITH, M.D., Section on Proctology, The Mayo Clinic, ROCHESTER, MINNESOTA

MALIGNANT tumors of the rectum are now most effectively dealt with by operation and by radium and roentgen-ray treatment: the best results will be secured by combining these procedures to meet the individual needs of the patient. Individual treatment is tedious in its application and demands the full co-operation of clinician, surgeon, radiologist, proctologist, pathologist and also of the patient. This paper deals chiefly with the problems confronting the radiologist in the management of these cases.

To facilitate investigation, 127 cases observed in the Section on Radium Therapy at The Mayo Clinic during the years 1926 and 1927 were selected for study. Table I shows that 71.64 per cent of these cases occurred between the ages of 40 and 69 years, and that 86 were men and 41 women. The youngest patient was a woman aged 23 and the oldest a man aged 86. The average age was fifty-four and eighty-nine hundredths years.

TABLE I

AGE INCIDENCE

Age	Men	Women	Total	
			Cases	Per cent
20-29	2	1	3	2.36
30-39	9	7	16	12.59
40-49	16	10	26	20.47
50-59	25	9	34	26.77
60-69	21	10	31	24.40
70-79	11	4	15	11.81
80-89	2		2	1.57
Total	86	41	127	
Average age years	56	55	54.89	

The data in Table II are from records of proctoscopic examinations and from notes made at the time of the operation. In 115 of the 127 cases proctoscopic examination was made at the Clinic. Digital examination of the rectum, proctoscopic examination, and operative notes are important aids in helping the radiologist to decide whether or not the lesion can be treated adequately by radium and roentgen rays.

The site and characteristics of the lesion in the rectum sometimes decide whether an adequate amount of radium, an inadequate amount, or none can be applied. It is sometimes tedious to expose lesions in the area of the rectosigmoid with or without colostomy. Some lesions cause a high grade obstruction and the lumen of the rectum cannot be explored throughout its extent; therefore, only incomplete treatment at best can be applied in many cases. As indicated in Table II, the majority of the rectal tumors in the series were in favorable sites for treatment.

In 79 cases (62.2 per cent) of the series colostomy was done at The Mayo Clinic. Colostomy had been done in ten of the thirteen cases in which operation was performed elsewhere. In 38 cases (29.92 per cent) colostomy had not been performed when radium was given. In only three cases (2.36 per cent) was exploration carried out. Local excision was carried out in only three cases (2.36 per cent). Surgical diathermy has a limited field; it has proved to be valuable in rapidly reducing the bulk of the tumor presenting into the rectal lumen. Operations were not performed in 26 cases (20.47 per cent).

The generally recognized surgical procedures are not essential, but in some cases

[1]Read at the Annual Meeting of the Radiological Society of North America, at Chicago, Illinois, Dec. 3-7, 1928.

TABLE II

SITE OF LESION AND TYPE OF TREATMENT IN 127 CASES

Site	Colostomy	Colostomy and posterior resection	Colostomy and anterior resection	Exploration	Local excision	Surgical diathermy	Operation elsewhere	No operation	Total	
									Cases	Per cent
Lower third	8	10		1	2		2	7	30	23.62
Upper third	6	2	1[2]	1			1	2	13	10.23
Middle third	5	3				1	1	4	14	11.02
Lower middle	5	2					1	2	10	7.87
Upper middle	8	2				1	1	4	16	12.59
Anorectal	3	4			1		2	3	13	10.23
Lower sigmoid	3		1						4	3.14
Rectosigmoid	6	4	2			1	3		16	12.59
Rectosigmoid and rectum	2	1	1	1			1		6	4.72
Entire							1		1	0.78
Not stated								4	4	3.14
Total	46	28	5	3	3	3	13	26	127	
Per cent	36.22	22.04	3.93	2.36	2.36	2.36	10.23	20.47		

[2]Posterior resection later.

are very desirable in facilitating applications of radium. As yet, operability in rectal carcinoma is not clearly defined; however, the classification recorded in Table III is suitable from the standpoint of irradiation. As a rule, operable lesions are small and freely movable and occur in sites suitable for a complete operation. When the proctoscopic report or the surgical notes contained statements concerning attachments to adjacent important structures the case was classified as borderline. In the inoperable group were placed all cases in which either the clinician or surgeon indicated that the case was inoperable on account of the character of the local growth, definite regional or distant metastasis, or the poor general condition of the patient. In the recurring group were included only those cases in which operation had been performed at The Mayo Clinic. In the modified group were classified cases in which some type of apparently inadequate or incomplete treatment had been given elsewhere.

In about 20 per cent of the cases in the series the lesion was considered to be operable, and it was noted that a third of the tumors in the lower third of the rectum were operable. Five cases were classified as borderline for operability. There were 78 cases in the inoperable group: twelve of the tumors were found in the lower third of the rectum; in thirteen cases the tumor was found in the middle upper portion of the rectum, and in eleven cases in the region of the rectosigmoid. In twelve cases recurrence followed surgical procedures at The Mayo Clinic. There were seven cases in the modified group.

The general condition of many of the patients was poor when they presented themselves for irradiation. In the surgical cases the patients spent a considerable number of days in the hospital convalescing and, all things considered, there was a strain on their reserve strength. In the inoperable, the recurring, and the modified groups, the steadily advancing carcinomatous process is usually responsible for the patient's general poor condition. The age of the patient is also a factor, since 64.55 per cent of them were more than fifty.

It is now seldom necessary to perform biopsy in order to make the diagnosis; how-

TABLE III

SITE AND CLASSIFICATION OF LESION

Site	Operable		Borderline		Inoperable		Recurring		Modified		Total	
	Cases	Per cent	Cases	Per cent	Cases	Per cent	Cases	Per cent	Cases	Per cent	Cases	Per cent
Lower third	10	33.33	3	10.00	12	40.00	3	10.00	2	6.66	30	23.62
Upper third	3	23.07			8	61.53	1	7.69	1	7.69	13	10.23
Middle third	1	7.14	1	7.14	9	64.28	2	14.28	1	7.14	14	11.02
Lower middle	2	20.00			7	70.00	1	10.00			10	7.87
Upper middle	3	18.75			13	81.25					16	12.59
Anorectal	2	15.38	1	7.69	7	53.84	1	7.69	2	15.38	13	10.23
Lower sigmoid	1	25.00			3	75.00					4	3.14
Rectosigmoid	3	18.75			11	68.75	2	12.50			16	12.59
Rectosigmoid and rectum					4	66.66	2	33.33			6	4.72
Entire									1	100.00	1	0.78
Not stated					4	100.00					4	3.14
Total	25		5		78		12		7		127	
Per cent	19.68		3.93		61.41		9.44		5.51			

TABLE IV

SITE OF LESION CLASSIFIED BY GRADE OF MALIGNANCY

Microscopic diagnosis	Lower third	Upper third	Middle third	Lower middle	Upper middle	Ano-rectal	Lower sigmoid	Recto-sigmoid	Recto-sigmoid and rectum	Not stated	Total	
											Cases	Per cent
Adenocarcinoma, not graded	2	1									3	2.80
Adenocarcinoma, graded 1	3	1	1	1	1	1		4	1		13	12.14
Adenocarcinoma, graded 2	6	4	7	4	8	1		6	3	1	40	37.38
Adenocarcinoma, graded 3	6	4	1	3	1	2	1	1	1		20	18.69
Adenocarcinoma, graded 4	4		1		3	2		1			11	10.28
Colloid carcinoma, graded 2	1				1	1			1		4	3.73
Colloid carcinoma, graded 3						1					1	0.93
Colloid carcinoma, graded 4	1		1								2	1.86
Epithelioma, graded 2	1										1	0.93
Epithelioma, graded 3	1										1	0.93
Epithelioma, graded 4	1					1					2	1.86
Inflammatory	2	1			1	1	2	2			9	8.41
Total	28	11	11	8	15	10	3	14	6	1	107	84.25
Cases not having biopsy											20	15.74

ever, it is well to examine a small specimen of tissue to ascertain the grade of malignancy of the tumor. Since 1925, in The Mayo Clinic, rectal tumors to be treated by radium have been graded. From the standpoint of irradiation it is important to know the grade of the neoplasm, since the initial and subsequent courses of treatment may then be more completely outlined. Surgeons are appreciative of the poor prognosis attending lesions in which malignancy is graded 4 and, therefore, recommend irradiation as the procedure of choice.

In 95 cases (84.25 per cent) the tumors were graded according to Broders' method (Table IV). The number of tumors in each grade is too small for comparison; however, if tumors in which malignancy was

TABLE V

CLASSIFICATION OF IRRADIATION APPLIED TO TREATED CASES

Site	Treatment by radium complete					Treatment by radium limited					Treatment by radium abandoned					Treatment by radium prophylactic					Total cases
	Cases	Courses of roentgen ray				Cases	Courses of roentgen ray				Cases	Courses of roentgen ray				Cases	Courses of roentgen ray				
		1	2	3	4		1	2	3	4		1	2	3	4		1	2	3	4	
Lower third	9	5	2		1	8	5	1								8	4			1	25
Upper third	5	3	1			6	4				1	1									12
Middle third	4	3				4	2				1					1	1				10
Lower middle	4	3	1			2	1	1			2										8
Upper middle	7	4		1		4	4				2					2	1				15
Anorectal	5	3	1			4	1				1					1					11
Lower sigmoid	1		1			1	1														2
Rectosigmoid	4	3	1			4	3				1	1				4	1				13
Rectosigmoid and rectum						4	3				1					1	1				6
Not stated	1	1																			1
Total	40					37					9					17					103
Per cent	38.83					35.92					8.73					16.50					
Cases not having radium treatment																					24

graded 1 and 2 are combined the total is 58 (61.05 per cent) of the graded tumors. The number in grades 3 and 4 is 37 (38.94 per cent) of the graded tumors. We feel reasonably certain that if repeated specimens had been taken of the growths reported as inflammatory, malignancy would have been shown.

We shall touch briefly on the technic of irradiation. In the main, the policy was to apply radium locally and support the applications with high voltage roentgen rays. When it was necessary to abandon the radium treatment, the cases were usually considered unsatisfactory for treatment by roentgen rays. In only two such cases was roentgen-ray treatment given.

The classification of the radium applications can be discussed under four headings: complete, limited, abandoned, and prophylactic. Such consideration helps to formulate an idea as to what was done for the patients. It is grossly obvious that all cases in which radium was used should not be grouped together. The patient receiving a complete treatment should have a better chance for complete local healing than the patient whose treatments were limited or abandoned on account of a definite contraindication to adequate treatment.

In 40 (38.83 per cent) of the 103 cases in which treatment by radium was carried out (Table V), complete radium treatment was given. In 37 cases (35.92 per cent) only limited radium treatment could be applied. It was necessary to stop treatment in nine cases (8.73 per cent). Every endeavor is made to keep the number of such cases as low as possible since their number tends to reflect on the judgment of the radiologist at the time the treatment is outlined. In 17 cases (16.50 per cent) prophylactic treatment following surgical intervention was given. Nearly all applications were made with the aid of a proctoscope. A competent proctologist can be of great service in accurately placing the radium applicator.

Applications were made to the surface. The strength of the applicator was usually about 50 milligrams of radium sulphate (element) or 50 millicuries of radon. The filters were 0.5 mm. of silver and 1.0 mm. of brass. The added filtration was 2.0 mm. of lead, and from 2.0 to 10.0 mm. of Para rubber, depending on the amount of necrosis present and the size of the canal or lumen

of the bowel in the involved area. The tumor was divided into one or more treatment fields, usually designated as a high, median, and low lumen field, each field measuring about 2.5 cm. in length. The time varied from two to sixteen hours for each area. One field was usually treated at a time; occasionally, two or more fields were exposed at the same time. There seems to be an advantage in the one-field treatment. There was usually an interval of two or three days between applications, and an interval of two or three months between courses of treatment.

In the female patient the rectal growth was treated with vaginal packs similar to the technic employed in treating carcinoma of the cervix uteri. The package contained the usual 50 milligrams of radium sulphate (element) filtered through the wall of the applicator: 1.5 mm. of monel metal, 2.0 mm. of lead, and 10 mm. of Para rubber. The time was usually fourteen hours. From one to four applications were made, at daily intervals, to different areas in the vagina.

Cases in which colostomy was not performed were treated in a general way with the same applicators; however, the time factor was reduced. This is considered cautious treatment, thus attempting to avoid obstruction through secondary contracture. We believe that the local disease can be favorably influenced to such an extent that obstruction is not likely to occur.

In cases in which definite inguinal lymph nodes are palpable, the space bearing lymph nodes was mapped out into six areas, each about 4 cm. square. The universal tube, previously described, was employed; filtration was the wall of the applicator and 2.0 mm. of lead maintained at a distance of 2.5 cm. by the interposition of a Balsa wood block, the base measuring 3 by 4 cm. Each area was exposed for fourteen hours. From three to six areas were treated at one time.

The applications of radium were immediately supplemented by high voltage roentgen rays, with the employment of the usual technic.

In the average case the treatment factors were as follows: kilovolts 200; distance 50 cm.; milliamperes 5; filtration, copper 0.75 mm., and aluminium 2.0 mm.; time, one hour and twenty minutes to each of four fields (one anterior field 20 by 20 cm., one posterior field of equal size, and two lateral fields 20 by 10 cm.). In cases in which the patient's general condition was good one field a day on successive days was treated. If the general condition was poor, the anterior field was divided into two, for treatments of forty minutes each on successive days. In some cases the posterior field was similarly divided. The intervals between courses of treatment varied from six to many weeks. The number of courses also varied greatly, depending to a great extent on the rapidity of the convalescence after treatment and the distance to be travelled. In cases in which the areas of the inguinal nodes were packed with radium, precautions were taken not to expose the treated field to roentgen rays.

As a rule, the treatments were well tolerated. In some cases nausea, vomiting, weakness, and diarrhea occurred, which usually responded to fasting and other ordinary measures.

In Table VI are listed the complications occurring during the treatment period. In one case pelvic cellulitis developed; however, convalescence was satisfactory. The case in which the peritonitis occurred was one of markedly advanced carcinoma in a young adult. It was evident that the risk of treatment was very great; nevertheless, circumstances warranted cautious applications. With the onset of peritonitis the clinical course was steadily downward, resulting in the death of the patient. The abscess of the liver was an unusual complication; however, it is appreciated that rectal carcinoma is usually infected secondarily and that metastatic tumors of the liver may show this

TABLE VI

COMPLICATIONS DURING AND IMMEDIATELY AFTER TREATMENT

Complication	Lower middle	Upper middle	Middle third	Total cases
Pelvic cellulitis			1	1
Peritonitis		1		1
Abscess of liver	1			1
Total	1	1	1	3

combination of events. In this case a malignant growth was not found associated with the abscess. The primary tumor when first seen was very large and necrotic; it was, however, responding to treatment, and when the patient died was found to be markedly reduced in size, and free of necrosis.

The immediate results of treatment are tabulated in Table VII. Cases were classified as improved when the rectal discharge, bleeding, odor, and pain were lessened or entirely absent. The improvement in general health was also taken into account, although it is not so reliable in estimating treatment effect, as it is known that colostomy alone will improve the patient's general condition. All cases in which any question or doubt existed were classified as indeterminate. The deaths listed occurred in the hospital. Of the 103 patients treated 92 (almost 90 per cent) were improved.

TABLE VIII

PRESENT CONDITION OF LIVING PATIENTS CLASSIFIED BY SITE OF LESION

Site	Apparently cured	Better	No change	Worse	Total
Lower third	2	6		2	10
Upper third	1	3			4
Middle third		1	1	1	3
Lower middle		1		2	3
Upper middle		1		2	3
Anorectal			1		1
Lower sigmoid		1			1
Rectosigmoid		3			3
Rectosigmoid and rectum					
Not stated			1		1
Total	3	16	3	7	29
Per cent	10.34	55.17	10.34	24.13	

Twenty-four patients were not treated. Three patients were examined subsequently and no activity in the primary treatment field was found, which demonstrates rather clearly to what extent local healing will occur. Although the favorable results are few, they, nevertheless, lend encouragement to workers in this as yet most discouraging field of irradiation. In one of the cases treated the malignant process had advanced to such an extent that further treatment was considered inadvisable. In ten cases the disease was considered too far advanced for

TABLE VII

IMMEDIATE RESULTS IN TREATED CASES CLASSIFIED BY SITE OF LESION

Site	Improved		Unimproved		Indeterminate		Deaths		Total
	Cases	Per cent	Cases	Per cent	Cases	Per cent	Cases	Per cent	
Lower third	24	26.08			2	25.00			26
Upper third	10	10.86			1	12.50			11
Middle third	10	10.86							10
Lower middle	7	7.60					1	50.00	8
Upper middle	13	14.13			1	12.50	1	50.00	15
Anorectal	11	11.95							11
Lower sigmoid	2	2.17							2
Rectosigmoid	11	11.95			2	25.00			13
Rectosigmoid and rectum	3	3.26	1	100.00	2	25.00			6
Not stated	1	1.08							1
Total	92	89.32	1	0.97	8	7.76	2	1.94	103

TABLE IX

SUBSEQUENT DEATHS AND LENGTH OF LIFE AFTER TREATMENT CLASSIFIED BY SITE OF LESION

Site	Length of life after treatment, months									Total	
	Less than 3	3 to 6	6 to 9	9 to 12	12 to 15	15 to 18	18 to 24	24 and over	Time not stated	Cases	Per cent
Lower third	2	6	4	1	1		1	1	2	18	
Upper third	1		1	1	1				2	6	
Middle third		2			1	1	2		3	9	
Lower middle			1	1	1	2			1	6	
Upper middle	1	1	3	1	2	1				9	
Anorectal	1	2	2		1	2				8	
Lower sigmoid		1						1		2	
Rectosigmoid	2	3	3	1	2				1	12	
Rectosigmoid and rectum	2	2								4	
Not stated		1				1				2	
Total	9	18	14	5	9	7	3	2	9	76	72.38
Per cent	11.84	23.68	18.42	6.57	11.84	9.21	3.94	2.63	11.84		
Patients living										29	27.61
Patients not heard from										20	19.04
Hospital deaths										2	1.57
Grand total										127	

applications of radium. An effort was made to apply radium in eight cases, but it was found impossible to treat the primary lesion. Since it is our practice to treat patients by the so-called broken-dose method, and observation during the intervals, two patients preferred to have the treatment at or near their homes.

The present condition of the patients living cannot be easily estimated. The data in Table VIII are not wholly reliable, since much depends on the time at which the letter of inquiry was received. The three patients listed as apparently cured demonstrate definitely the value of the treatment. Furthermore, it is known from daily contact with patients that improvement does occur with treatment. The degree of palliation and the length of the period of improvement varies in individual cases, since there are many other factors to consider aside from the treatment field.

As shown in Table IX, 23 per cent of patients lived from three to six months, 18 per cent lived from six to nine months, and 34 per cent longer than nine months. The life expectancy of these patients before treatment is usually in terms of only a few months. It seems evident that their lives have been prolonged and it can be safely concluded that the activity in the treatment field was reduced, thus diminishing distressing complications caused by the local extension of the disease. That the local activity of the primary tumor can be reduced is a feature of the treatment worthy of emphasis, as it adds greatly to the patient's comfort. For example, death due to metastasis to the liver is as a rule painless in this dreaded disease.

SUMMARY

The majority of the cases in the series were inoperable, due to the size and extent of the primary lesion, local metastasis, metastasis to important viscera, or the patient's poor general condition. Adenocarcinoma of a rather moderate degree of malignancy

predominated. These tumors are sensitive to irradiation, although they vary in degree of sensitiveness.

In the cases selected for irradiation alone colostomy can be placed in the background. However, if indications are definite it should be done. Colostomy splints the bowel, affords better methods of cleansing, and is an aid, although not essential, to thorough treatment.

Diagnosis is usually readily made by palpation and proctoscopic examination: in only a few cases is biopsy necessary. However, a specimen should be removed since the grading is important to both surgeon and radiologist.

The size, character, situation, and grade of malignancy of the rectal growth, as well as the general condition of the patient, should determine the treatment factors; a standard treatment should not be employed in all cases. As yet, definite recommendations regarding the most effective treatment cannot be made.

The risk of treatment by radium is very small and it would seem that almost all patients should receive the benefit of individual treatment. Radium and roentgen rays alone in selected cases or in combination with surgical procedures will afford the best results. Every endeavor should be made to individualize treatment. Prophylactic treatment seems indicated in all cases in which adequate surgical intervention is employed; however, it can be applied only as a routine measure. All patients should be under careful and repeated observation.

Palliation can be expected from reducing or minimizing the potentials for destruction inherent in the primary growth, thus adding greatly to the comfort of the patient. Improvement consists in lessening of the rectal discharge and the pain, in the reduction in the size of the tumor, and in the cessation of bleeding.

Results are in the main encouraging. There must be full co-operation of all concerned in the care of the patient. The assistance of a competent proctologist is highly desirable from the standpoint of good results.

CASE REPORTS

THE ROENTGENOGRAPHIC DEMONSTRATION OF STERNAL INJURY, WITH REPORT OF A CASE

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Fractures of the sternum, or dislocations of its parts, are rather uncommon injuries, judging from the scanty references in the literature. A review of the published reports from 1916 to 1928 discloses few dealing with these injuries or X-ray studies of them.

In 1921, P. Bonnet and L. Barbier (1) reported a case of fracture of the sternum, with rupture of vessels. R. Gutzeit (2), in 1924, reported a fracture of the sternum from muscle contraction. In 1926, E. Pazzi (3) reported the roentgenographic demonstration of an anterior dislocation of the sternal body upon the manubrium. C. E. Bird (4), in 1927, reported a fracture of the xiphoid as causing clonic spasm of the diaphragm.

Delherm and Chaperon (5), in 1920, published an article dealing with studies of the sternum in the right oblique position. In 1924 Pfahler (6), in an article in the *American Journal of Roentgenology and Radium Therapy*, called attention to the need of more thorough study of the sternum by roentgenologists. He presented several excellent examples of sternal disease, demonstrated by radiographs made in the direct lateral position, and mentioned the futility of attempting fluoroscopic diagnosis of such lesions. He also stressed the inability of stereoscopic and Bucky diaphragm technic to adequately portray sternal pathology, and advised the use of the right oblique, left oblique, and direct lateral projections.

NECESSITY FOR PROPER ROENTGENOLOGIC STUDY OF STERNUM

As mentioned by Pfahler, several diseases may present lesions of the sternum as part of the pathologic picture. Among these, he mentions carcinoma, tuberculosis, aneurysmal pressure necrosis and others.

Even more commonly, the question of injury of the sternum arises. Where there has been a crushing force affecting the chest wall, the first thought is usually directed toward rib fractures or dislocations, and injuries to the spine. It is very likely that many sternal injuries go undiagnosed because of the difficulty of determining the extent of such injuries by physical examination, and the lack of thorough X-ray studies.

While it is true that surgical correction of sternal damage is rather difficult to apply, it is nevertheless important to know the extent of injury present in order to evaluate properly the patient's complaints of chest pain, dyspnea, etc., often arising in thoracic injuries. A really complete study of cases in which there has been crushing or widespread injury of the thorax should include examination by X-ray for spinal, rib, sternal, and lung pathology. Even then, there may be damage which we cannot demonstrate, as in one case examined by the writer in which a man was thrown from a mule and sustained not only a fracture of the skull but a rupture of the descending thoracic aorta, without rib, spine, or sternal injury being demonstrated on the roentgenograms. Although a widening of the aorta was noted on examination of the chest, the aortic rupture, which was of the dissecting type, was not diagnosed by the X-ray but was found at autopsy.

METHODS OF EXAMINATION OF THE STERNUM

As recommended by Pfahler, the oblique and lateral positions are employed by the writer, but the direct lateral projection is considered to yield the maximum information in sternal injuries.

The technic is modeled after that of Pfahler, with slight modifications. Where he employs a 4½ inch spark gap, 30 ma., 40 in. distance, and 8 to 12 seconds, 8 x 10 film, double screens, medium cone, the writer uses, instead, a 5½ inch gap, 30 ma., and 4 to 7 seconds, other factors remaining the same. The use of a slightly higher voltage and shorter time does not appear to appreciably alter the detail obtained, while it is easier for the injured patient to suspend respiration during the shorter exposure time. When possible, the patient is seated before a vertical plate holder; if this is not practical, he may be turned on his side on the horizontal table, as also suggested by

Fig. 1. Lateral projection of sternum. Note posterior depression of manubrium, with manubrium and body fractures. The cervical spine shows bone spurs. Note calcified areas posterior to tracheal shadow.

Pfahler. When it is not feasible to turn the patient at all, the sternum may be studied by supporting a plate alongside the body, and turning the tube so that the rays are directed horizontally across the chest.

Here, as elsewhere, a knowledge of anatomy is of importance, especially in making a diagnosis of undue separation of the various portions of the sternum. A recognition of variations in shape due to congenital deformity, rickets, and like conditions is also of value.

CASE REPORT

The following case was referred by Dr. Henry A. Smith, of the Wise Clinic, Americus, Georgia.

A white woman, age 55, was injured in an automobile collision January 20, 1928. When first seen, she complained of pain in chest, neck, and back; dyspnea, and a feeling of tightness in the chest. There was a noticeable depression of the upper sternum, and a kyphosis of the thoracic spine. Physical examination of the chest showed no evidence of pulmonary or cardiac pathology of an organic nature. Heart rate 90; blood pressure 160/94. Due to the patient's extremely nervous condition and her age, she was left in bed at home, where first seen, for six weeks. There was severe pain in the back of the neck and in the shoulders on the least attempt at motion. There was no paralysis, sensory or motor. Two months after the accident, she was referred to the writer for X-ray examination. At this time the pain in the back, neck, and shoulders had decreased, but the sensation of tightness in the chest remained. The patient was able to walk a little, and could sit up with a moderate degree of comfort. X-ray studies of the thorax and spine disclosed the following:

"There is a posterior depression of the manubrium sterni upon the body, with fracture of the manubrium. There is an incomplete fracture of the body just below the articulation with the manubrium.

"There is a compression injury of the fourth thoracic vertebra, with resultant kyphosis of the thoracic spine.

"The entire cervical and thoracic spine shows a productive arthritis, with spur formation on the vertebral bodies.

"There are several small calcified areas anterior to the cervical spine and behind the trachea." (See Fig. 1.)

In view of the patient's age and general condition, it was thought best not to attempt any radical treatment of either the spinal or sternal injury. At the present writing, March 7, 1929, one year from the date of the X-ray examination, she suffers only a slight inconvenience from her injuries, although there is still some dyspnea and a sensation of tightness in the chest.

The case is somewhat unusual in the following respects: (1) In spite of the injury to the spine and sternum, there were no demonstrable fractures of the ribs; (2) there were no symptoms, physical findings, or X-ray evidence of pulmonary injury, other than the dyspnea and sensation of tightness in the chest; (3) the nature of the sternal injury was evident on physical examination, but radiographs in the direct lateral position of Pfahler afforded a complete disclosure of the exact character and extent of the injury.

SUMMARY

1. The literature for the last twelve years is briefly reviewed with respect to fractures and dislocations of the sternum and the roentgenographic demonstration of these injuries.

2. The value of careful roentgenographic study of sternal injuries is emphasized.

3. A slight modification of Pfahler's technic for lateral projection of the sternum is suggested.

4. A case of combined fracture and dislocation of the sternum, together with spinal

fracture, is reported, with radiograph demonstrating the value of the lateral position in examination of the sternum.

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BENIGN TUMOR OF THE STOMACH

REPORT OF A CASE

By LOUIS H. LEVY, M.S., M.D.
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The final decision as to the malignancy or non-malignancy of a tumor must rest with the pathologist and is made from the histological examination of the suspected tumor. This necessitates the removal of the tumor. There are times when it is neither expedient nor advisable to remove the tumor. There are other times when from the history, examination, and X-ray studies doubt arises as to the class under which the tumor classifies, and "watchful waiting" seems to be the proper course.

Benign tumors of the stomach are uncommon. In all the literature, not over one thousand cases have been recorded. These cases include all types of non-malignant tumors, such as papillomata, myomata, angiomata, polypi, adenomata, lipomata, cysts, fibromata, myxomata, and lymphadenomata. Carman found two cases in fifty thousand stomach X-ray examinations. The case to be described is the first seen by the writer in over six thousand X-ray examinations of the stomach.

Most of the cases described have been confirmed post-operatively or at autopsy. A diagnosis of benign tumor of the stomach pre-operatively can be only presumptive at best, and yet there are certain roentgenologic characteristics of some types that have been described. With the larger visible tumors, there are certain constant features which tend to distinguish the benign from the malignant. Eliason and Wright in a study of fifty cases state: "The single tumors which are large enough to be describable stand out as globular, smooth, regular, clear, and persistent shadows, alike on the lesser and greater curvature, and by their very smooth uniform outline immediately strike one as not characteristic of the irregularity of malignancy or the scooped- or punched-out area of ulceration." Inasmuch as the case to be described here seems to fit in with this description, and because of other features to be mentioned later, it is considered to be a case of benign tumor of the stomach. And, because of this, operation was held in abeyance. Subsequent events, since the first examination, have tended to substantiate this opinion.

The patient, Mrs. K. J., housewife, age 42, was first seen on April 8, 1928. Her chief complaint was epigastric pressure. There was no regularity as to the occurrence of the attacks. One year previously she had had one series of attacks which had lasted about one month. The present series of attacks had begun four weeks before her visit to me. These attacks would come on as often as two or three times daily. Occasionally she would have a day free from attack. They came on about two hours after meals and lasted only a short time. Twice she had been awakened after midnight with bad attacks. Alkalis and walking seemed to offer the greatest relief. The

Fig. 1. Seriatograph taken April 9, 1928, showing persistence of defect in lower half of stomach.

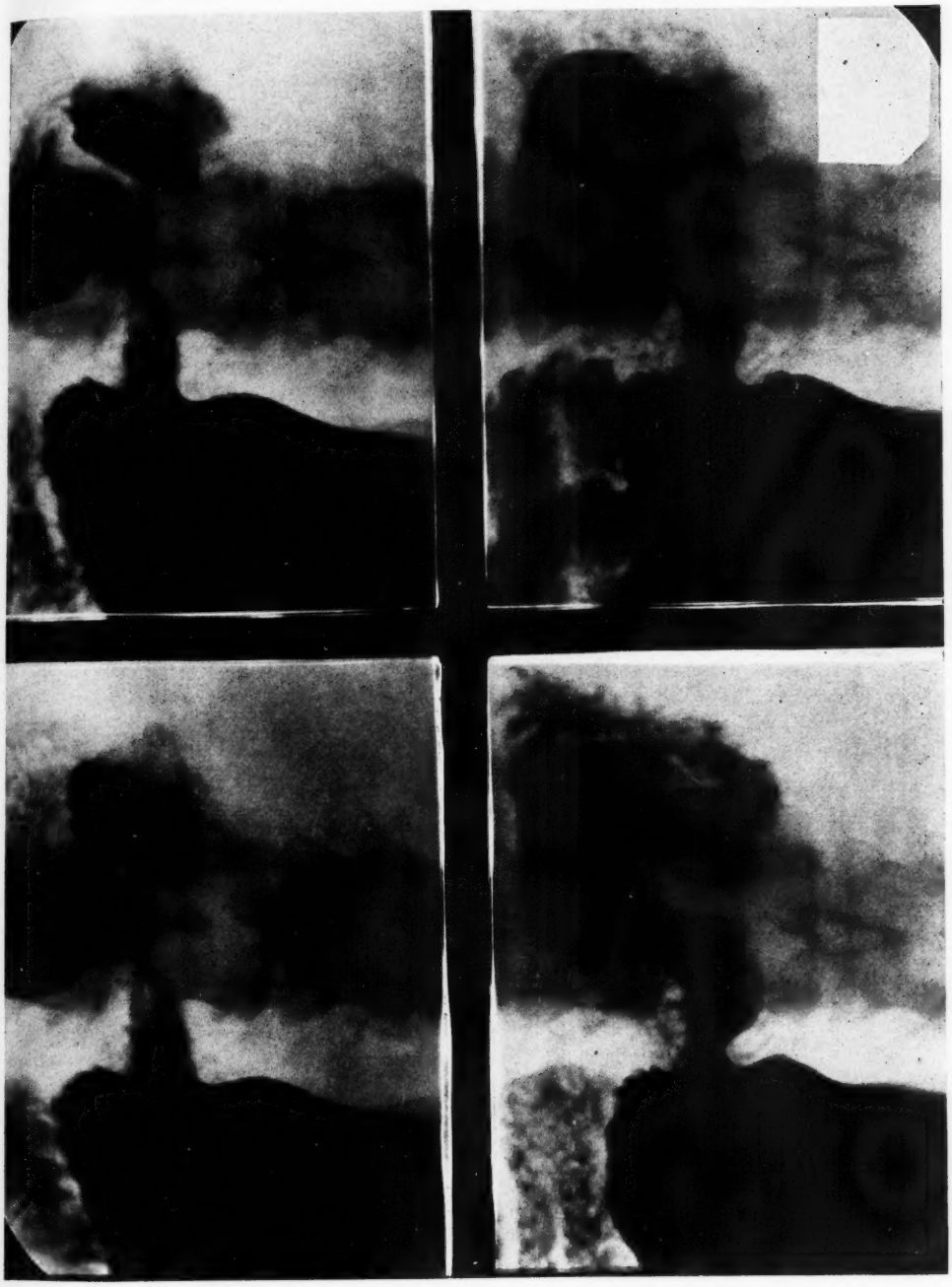


FIG. 1. Serialegraph taken April 9, 1928, showing persistence of defect in lower half of stomach.

attacks were associated with bloating and at times there was slight pain in the epigastrium, radiating straight through to the back. There was also a heaviness, with pressure, increased by lying on the right side. Occasionally she had been nauseated but had

Fig. 2. Film taken June 15, 1929, showing unchanged appearance of defect in lower half of stomach.

never vomited. She had had no headaches or dizziness. There was very slight belching, which gave relief, but no sour taste, no heartburn, and no regurgitation. There were no dyspneic attacks. The appetite had been fair, but the patient had been afraid to eat. She slept well. She was costive as a rule, and had to use a slight amount of cathartics. There had been no urinary disturbance, no jaundice, no history of chills or fever, and no loss of weight.

In 1921, she had been operated on for fibroid of the uterus and a partial hysterectomy performed. Since that time her menses, though regular, had been scant. She had had a mild nervous breakdown in 1924. There had been an intermittent history of slight gastric disturbance over a period of sixteen years. She had one child who is now alive, and no miscarriages. As far as could be ascertained, there was no history of lues in either her family or her husband's.

On examination, the patient appeared well nourished, weighing 143 pounds. She seemed to be of a nervous type, but more of the hyperesthetic type than the so-called neurotic type. The sclera were clear and there was no evidence of conjunctival icterus. Pupillary reaction was normal. There was no corneal anesthesia. The mouth and throat examination was negative. There was no pharyngeal anesthesia. No glands were palpable. The chest examination, including both heart and lungs, gave no evidence of involvement. Reflexes were nor-

mal. On examination of the abdomen there was no evidence of wasting, but, instead, a marked panniculus. There was slight tenderness high up in the epigastrium, and very marked tenderness midway between the umbilicus and ensiform, with less tenderness over the descending colon. Because of the marked tenderness in the mid-abdomen it was impossible to make out anything indicative of a mass.

A test meal showed a free acid of twenty and total of forty. There was no blood or evidence of obstruction. The Wassermann was negative, as were the stool, urine examinations, and blood findings.

The X-ray findings gave the first indication of the nature of the gastric disturbance. Using the fluoroscope, the marked defect in the second third of the greater curvature was first noticed. This mass was firmly adherent in the stomach and persistent in size and shape during the manipulation. At times there could be seen a definite spasm at the constricted portion, which appeared almost faucet-shaped. Associated with the spasm brought on by palpation was a sharp attack of pain, which disappeared as the spasm subsided, and as more of the bolus passed through to the pyloric end of the stomach. Although the defect at no time changed its appearance, the constricted portion did, becoming either narrower or fuller, varying with the regular movements of the stomach. During palpation, the defect, as can also be seen on the film (Fig. 1), was unusually smooth in contour and showed no raggedness or irregularities of the edges.

There was no retention at the end of six hours and the 24- and 48-hour films were normal in every way.

The diagnosis made was that of an intragastric growth. From its appearance on the films, from the history of the case, the patient's appearance and other findings, the question of a benign newgrowth was considered. This matter was taken up with the patient. Because of the seriousness of the operation, the question of post-operative complications, and also the possibility of non-malignancy, the patient decided to hold operative interference in abeyance and to take the chance offered by waiting. It was decided to make frequent examinations and to make X-ray studies at short periods, and institute surgical procedure only if any occasion arose that would warrant it. The patient was placed on medication and soft diet. The following notes are taken from the subsequent history.

April 27, 1928.—Patient "feels wonderful"; no symptoms. Has "ravenous appetite," bowels are regular, weight is 150 pounds.

May 20, 1928.—No attacks; patient eats well; weight 157 pounds.

Oct. 13, 1928.—Feeling fine; no attacks; weight 158 pounds.

Feb. 27, 1929.—Feeling fine; no attacks; weight 159 pounds.

June 15, 1929.—Has "never felt so well"; weight 160 pounds.

It is plausible to assume that with an increase in weight of seventeen pounds over a period of fourteen months, with a complete absence of symptoms over the same period, with the sense of well being in every way, and no changes in the appearance of the defect, that we are dealing with a benign tumor of the stomach. It is impossible to state the type of tumor it may be, or from what part of the gastric wall it has originated, nor is it possible to say what changes may take place in the future. However, all things taken into consideration at this moment, it is offered as a most probable case of benign tumor of the stomach.

EDITORIAL

DENTAL SEPSIS

It is now generally acknowledged by physicians and surgeons that dental sepsis is often the primary and underlying focus of infection and toxin production in many local and systemic disorders. The acute inflammatory dental lesion which progresses and eventually leads to the death of the patient by the involvement of vital centers or general septicemia is well known; likewise, dental sepsis producing empyema of the antrum and sometimes infection of all the accessory sinuses. Further, many observers have proved that certain inflammatory conditions of the eye and skin, degenerative changes in joint structures and the cardiovascular system may be due to absorption from septic teeth.

Dr. Leonard Mackey and others have published the histories of patients who exhibited grave systemic disorders and obscure pyrexia, which have cleared on the discovery and eradication of obscure dental sepsis. The earlier medical observers who suspected, and proved to their own satisfaction, that septic teeth were the cause of many obscure illnesses were confronted with the fact that many patients with obvious dental sepsis show little or no disability other than perhaps vague digestive disturbances. The researches of Price indicate that patients with marked pyorrhea and obvious dental sepsis seldom show evidence of the "rheumatic" degenerative disorders, but, on the other hand, these affections are common in patients harboring obscure foci of dental sepsis.

The detection of these obscure and hidden foci of dental sepsis is achieved by means of radiography and to radiography the credit should be given. Formerly a medical man who condemned patients' teeth because he regarded them as the source of infection, and asked the dental surgeon to extract them, frequently met with considerable opposition or even refusal, particularly in those cases in which no local evidence could be obtained. Now he can produce radiographic evidence that septic processes are present, but, even armed with this extra evidence, he cannot always induce the dental practitioner to accept his advice.

We know that radiographs will not show changes in every septic tooth, but then, acute inflammatory changes are usually obvious to the patient, and the dental examiner often can and usually does deal with the problem without radiography. It can be said, particularly in the acute conditions, that the more obvious the local physical signs and symptoms, the less the radiographic signs. Even where the local dental examination appears to be conclusive, radiography may give much useful additional information. Thus the radiographs may show that the acute lesion is due to a flare-up in an unsuspected chronic focus, a septic tooth which the local examination has not detected.

The most important fact is that every tooth which is acting as a chronic source of toxin-production will show definite changes on a carefully made radiograph, yet such

teeth may give no local symptoms or signs detectable by the patient or dental examiner. The changes shown on the radiograph may be small in point of size, but this is no measure of their actual or potential danger to the patient. It is the demonstration of these obscure and unsuspected foci of dental sepsis which makes radiography invaluable.

One has seen radiographs showing the appearances of large apical "abscesses" which have eroded the apices of several teeth in patients suffering from the effects of toxemia, who have been absolutely unconscious of the "abscesses," and the lesions have been undetected after several most careful local examinations by skilled dental surgeons who have been asked to eradicate any focus of sepsis.

From these undetected lesions the absorption of toxin continues, the patient is sensitized to the infection, and the toxins exact their toll on the tissues of the patient, until either his resistance is broken down by some contributory debilitating cause such as fatigue, anxiety, cold, influenza, shock, pregnancy, etc., when the effects are manifested by the "rheumatic" type of degeneration, or by the development of secondary septic foci of grave significance, and the dental lesion, even if discovered at this stage by radiography, appears to be a minor detail. Unfortunately, if the dental septic focus be eradicated now the secondary lesions which have arisen from it may be beyond repair, and failure to recover tends to discredit the significance of the primary focus.

With local examination by an expert and careful radiography it is possible to distinguish the healthy from the diseased teeth; and only those teeth should be extracted which show evidence of pathological changes. Wholesale extraction without a complete local and radiographic examination is to be condemned, as the treatment may fail to alleviate the symptoms of which the patient complains and provide the cause for the production of gastro-intestinal disturbances.

On the other hand, even when the radiologist has demonstrated definite appearances which he knows to be indicative of sepsis, some dental surgeons ignore the radiographic findings if the tooth appears sound or "useful." Teeth which the radiographs show to be definitely septic and even which, on opening into the pulp canal, are seen to be septic, are sometimes root-filled—a practice which is dangerous and surgically unsound. Grave constitutional disorders, septicemia, and death have followed this procedure.

It is essential in dental radiography as in all radiography that the radiographs be taken by skilled technicians and that the interpretation be made by a radiologist who has familiarized himself with the normal and variations from the normal anatomy of the parts, the pathological changes which these parts undergo, and the radiographic appearances of these structures. His general knowledge of bone pathology and its radiographic interpretation is of great value, but in itself is insufficient if his report is to be of the best service to the physician or dental surgeon.

Unfortunately the manufacturer has produced apparatus which is described as "foolproof" and he has induced many to buy and use such apparatus without any knowledge of the technic of photography or radiography. Such apparatus is used with varying success in the production of radiographs, and one can only assume from the wealth of faulty interpretation, that little care has been taken to acquire even a knowledge of the appearances on the radiographs due to faulty photographic technic, or the appearance of the normal and pathological changes in the teeth and bone. It is chiefly on account of the production of radiographs and their interpretation by incompetent workers that we hear so much about the "pitfalls of radiography," most of which

Government House, Toronto, the official residence of the Lientenant-Governor of Ontario

are demonstrations of gross ignorance. One can think only that the cause for much of this type of radiography is that the producer is actuated by the reason given by a well known book on Dental Pathology in which, recommending the reader to do his own radiography, it states: "Such profits as may accrue are his."

Faultless radiographs coupled with a report showing a lack of knowledge of dental anatomy and pathology bring dental radiography into disrepute, and faulty radiographs may mislead the most skillful clinician.

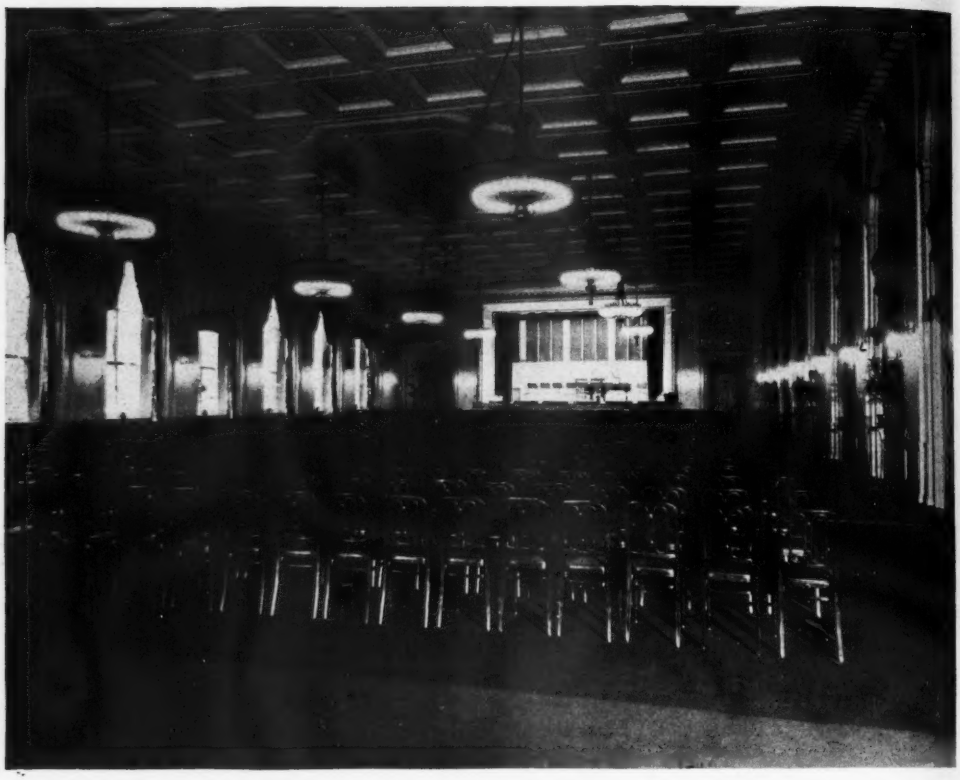
It is probable that the reason why some dental surgeons do not give full significance to foci of dental sepsis, whether detected by local or radiographic demonstration, is that they see the patient either before any metastatic foci or degenerative changes have occurred, or when the latter are so important and dominant that the primary dental focus appears insignificant.

The patient is always desirous of avoiding extraction and frequently judges the skill of the dental surgeon by his ability to "save" teeth, even though they are found to be septic. Depending on his experience, the dental surgeon advises the patient that (1) extraction is the only and proper line of treatment and that all other measures are uncertain and render the patient liable to dangerous degenerative and infective processes; or (2) that the attempt can be made to save the tooth for a year or so; or (3) that the tooth can be saved by careful root-filling. Unfortunately when either of the

Trinity College, one of the affiliated colleges of the University of Toronto

last two decisions are adopted, the patient is not made aware of the potential dangers of this treatment. He does not understand that devitalization of the tooth destroys Nature's warning of progressive sepsis or toxin production, and that this can occur without revealing signs detectable by the local dental examination. A year or two may pass and with the absence of local symptoms the septic tooth is forgotten. Unfortunately also the patient's doctor is not notified that a septic tooth has been root-filled. On the development of symptoms of toxic absorption he may have referred the patient to the dental surgeon, who may even X-ray the teeth and report that they are sound—and if the doctor is satisfied with this report, the septic focus is missed.

There is no question but that the correct treatment for any tooth in which the pulp has been infected is extraction, whether the evidence of such infection is based on local or radiographic examination. No alternative should be offered. If the patient insists on the saving of the tooth, the dental surgeon should protect himself by giving a full warning of the dangers to the patient or to a responsible relative, and also to the patient's doctor. If the tooth shows no evidence of sepsis and root-filling is performed, it should be radiographed from time to time for the detection of septic changes. If the radiography has been done by an independent observer, the dental surgeon is provided with the additional support which may be necessary to influence the patient to adopt



Concert Hall of the Royal York Hotel, Toronto, a splendid audience chamber. The Society's Annual Meeting will be the only meeting during the week of December 2 to 6 in this hotel.

the right method of treatment, and thus is protected in case of any legal procedure.

For these reasons it is essential that dental radiography should be performed by independent and unbiased persons who are skilled in its technic and interpretation.

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JAMES F. BRAILSFORD, M.D., M.R.C.S. (Eng.)

The Queen's Hospital,
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England.

AN INVITATION TO THE ANNUAL MEETING

During the first week of December the Radiological Society of North America will hold its Annual Meeting at Toronto, in the Royal York Hotel, convening Monday, the 2nd, and continuing with Scientific Sessions and exhibits until Friday afternoon, the 6th. The members, exhibitors, visitors—and the households of all of them—will make it by their very presence an occasion of interest and pleasure. The best-laid plans of the committees can do little more than supply the background—in the personnel of the assembled company lies the whole merit of these Annual Meetings. Here the country's radiologists are establishing traditions and forming groups and making ties which will profit all—the pioneers and the beginners.

Whether one is or is not a member of the Society, if only he is associated with us in

Ballroom of the Royal York Hotel, Toronto, where the annual dinner and dance of the Society will be held.

interests, he is welcome to join us at our Annual Meeting, where we study and discuss new developments, report work already done and results achieved—and play a little.

M. J. HUBENY, M.D.
President.

DR. L. C. KINNEY HONORED BY HIS STATE MEDICAL ASSOCIATION

The California Medical Association has elected Dr. L. C. Kinney, of San Diego, to succeed to the presidency for next year, taking office in May. He has been a member of the Radiological Society of North America since 1921. Dr. Morton H. Gibbons, of San Francisco, is President this year; Dr. Edward M. Pallette, of Los Angeles, Speaker of the House of Delegates, and Dr. Emma W. Pope, of San Francisco, Secretary and Treasurer.

THE MEETING PLACE AT TORONTO

When the Radiological Society of North America meets in Toronto, the first week in December, it will be supplied with exceptionally fine facilities for holding its meetings, as will be seen from the illustrations appearing in this issue.

The "convention floor" of the Royal York Hotel has been laid out with a view to furnishing the maximum space to meetings of this nature, at the same time ensuring complete privacy. The largest of the rooms, the Convention Banquet Hall, capable of seating over 1,700 persons, will be available for the commercial and scientific exhibits; the Concert Hall, which is almost as large, will serve for the general sessions, while several smaller rooms with a seating capacity of about 100 each should give ample

space for the smaller meetings and clinics. Peculiar features of the Concert Hall are a large, fully-equipped stage and a magnificent organ, while microphones and loud speakers form a part of its permanent equipment. The third large room of the "convention floor" is the beautiful Ballroom, which can be used for both banquets and dancing.

As all these rooms are only two floors above the main lobby of the hotel they are located in a position of the greatest convenience.

It should be borne in mind that Toronto is so centrally located that the majority of our members can reach it by an overnight journey, and as the Royal York lies directly across the street from the Union Station one can be at the place of meeting within a few minutes after leaving the train.

A. H. ROLPH, M.D., Toronto,
Chairman, Committee on Publicity.

WOULD BREAK BELGIAN RADIUM MONOPOLY

The Belgian monopoly of radium, indispensable in the modern treatment of cancer, has led to such a revolt in medical circles that it is confidently expected that American money will soon be put into radium mines in Colorado and Utah, and possibly also in West Africa.

Just how cheaply radium can be produced from American ores in Colorado and Utah, will not be known until the Bureau of Mines does considerably more experimental work. Provision for such experimentation will be made in a bill to be introduced in the House this Fall by Representative Edward T. Taylor, of Colorado. At present, it is believed that it probably would cost at least $22,000 per gram to recover radium from American ores.

It is charged that Belgian interests produce it for $10,000 per gram, while selling it for $70,000 per gram.

In West Africa it is claimed that radium can be extracted from pitchblende for $8,000 per gram by a new German process. Efforts are now being made to interest American investors in these African pitchblende fields, it is said.—*Science Service.*

NON SEQUITUR

By I. S. TROSTLER, M.D., F.A.C.R., F.A.C.P.,
CHICAGO

Judging from a decision rendered by the Supreme Judicial Court of Massachusetts, the physicians in the Old Bay State recently sustained another serious setback because of an adverse ruling relative to collection of legitimate fees rendered in emergency cases and for industrial accidents.

Dr. S. sought to recover compensation for services rendered, following an industrial injury to an employee of a corporation insured by an insurance company. The Industrial Accident Board denied the claim, but the Superior Judicial Court gave the physician a verdict.

The insurance company appealed the case to the Supreme Judicial Court of Massachusetts, which reversed the decision of the lower court and entered a decree for the insurance company, on the following grounds: "When the injured employee was taken to the hospital, he told the nurse that he knew no Doctor at the hospital, and the nurse suggested Dr. S. *The patient acquiesced in the suggestion,*[1] and Dr. S. treated him. The insurer paid the hospital bill. The law provides that during the first two weeks after an injury the insurer shall furnish adequate and reasonable medical and hospital services. As the court construed the finding of the Industrial Accident Board, the insurer did all that was required of it in furnishing the employee with adequate and reasonable medical and hospital services," and, said the Court, "Physicians as well as nurses are generally expected to be in attendance at a public hospital. A patient who has been taken to such an institution,

[1] Italics mine.

if he has no physician of his own to treat him, naturally expects that he will receive treatment from someone on the staff. When an injured employee under the compensation act goes to such a hospital and does not select a physician, the payment to the hospital of its charges includes the expenses of nurses and physicians, and the insurer is not required to pay the physician who is a member of the staff for his services."

The Supreme Court approved of the finding of the Industrial Accident Board that the injured employee *did not in this case choose a physician,* holding that in accepting the suggestion of the nurse, he did not make such a selection as the statute contemplates when a patient selects a physician other than the one provided by the insurer.

Obviously, this decision will apply to every roentgenologist in Massachusetts, where services are rendered to injured employees and where the employee does not specify who should make the roentgen examinations. Every roentgenologist in Massachusetts, *in every industrial case,* will be wise if he requires a statement from the injured employee that he is the latter's selection.

A scene on Yonge Street, Toronto

ABSTRACTS OF CURRENT LITERATURE

INDEX TO ABSTRACTS IN THIS ISSUE

Two Cases of Nasopharyngeal Fibroma Treated by Operation and Followed by Radium. A. H. Persky. Laryngoscope, July, 1929, XXXIX, 460.

In this article the author reviews the literature on nasopharyngeal fibroma treated both by surgery alone and by radium alone. He goes on to report two cases in his own practice, both of large fibromas in boys aged 10 and 15 years. In these two cases he combined surgery with radiation to prevent recurrence, and eight months later none had made its appearance. He feels that the use of the snare and adenoid punch in the removal *per via naturalis* is the method of choice, followed by radiation with radium to prevent recurrence. In his hands there was no evidence of any cartilaginous or bony destruction due to the radium.

B. C. CUSHWAY, M.D.

Comparative Measurements with German Ionization Instruments and the Relation between R-unit and Erythema Dose at Different Qualities of Radiation. Günther Hin. Strahlentherapie, 1929, XXXI, 575.

The author has compared four ionization instruments (Küstner, Martius, Wulf, Chaoul) with the photometer of Wintz and Rump. He finds that they show small but noticeable deviation in their recording of the erythema dose. He did not find any dependence of the wave length within the range of short wave length (filtered deep therapy radiation). The photometer of Wintz runs parallel to the biologic reaction; when using the other instruments, one has to consider in each case how many R of a certain quality of radiation should be given as erythema dose.

E. A. POHLE, M.D., PH.D.

The Future of Medical Radiologists. L. A. Rowden. Brit. Jour. Radiol., December, 1928, I, n. s., p. 447.

Due to encroachment by Medical Officers of Health and full-time school clinic workers, to the widespread practice of referring private patients to hospital departments, and to the extensive utilization of the X-ray by clinicians in their own offices, the field of work for the private radiologist is growing increasingly narrow in England. The remedy for the situation, as suggested by the writer, lies in catering particularly to the general practitioner and in maintaining and cultivating a broader clinical knowledge in order to minimize incorrect diagnoses. Discussants of this paper brought out the fact that the situation is much

the same in England, America, and Europe generally, except that in Sweden only those physicians with special qualifications are allowed to practise radiology.

J. E. Habbe, M.D.

Experimental Production of Roentgen-ray Cataract. W. Rohrschneider. Strahlentherapie, 1929, XXXI, 596.

It is possible to produce cataracts in rabbits' eyes with much smaller doses of roentgen rays than recorded heretofore in the literature. It is necessary to observe the animals over a long enough period, that is, up to 283 days. The lens is the most sensitive part of the eye. About 150 per cent of the epilation dose for the rabbit (188 K.V., 0.5 Cu. + 3.0 Al., 1,340 R) produced a cataract 148 days following the exposure. The cornea and conjunctiva are only half as sensitive as the lens. In human beings, the latent time has been as high as five years. The author reported such a case recently in which, following X-ray therapy to the eye, the first signs of cataract appeared after five years.

E. A. Pohle, M.D., Ph.D.

On the Question of Disturbance in Growth in Cases of Irradiated Bone and Joint Tuberculosis. Hermann Hueck and Walter Spiess. Strahlentherapie, 1929, XXXII, 322.

The authors analyze in this article all cases of bone and joint tuberculosis which were observed during the period 1914–1927. Only those are reported in the statistics which were treated while under twenty years of age; this left a total of 76 patients for a comparative study. In 15 patients, there was no disturbance in growth noticeable; in 60 patients, there was definite inhibition—eleven of these showed only a difference in circumference of the extremity while 49 showed differences in both circumference and length. In only one case did they notice increased growth. They conclude that this disturbance is in all probability not due to irradiation but undoubtedly must be blamed on the disease itself, which affects the epiphyses and leads to loss of bone due to necrosis. The inactivity of the extremity plays also an important rôle. There is no doubt, however, that following heavy doses of roentgen rays such disturbances in growth may be due to the treatment. The advisability of the use of small to medium doses in the treatment of bone tuberculosis has been accepted by all clinics.

E. A. Pohle, M.D., Ph.D.

Laboratory Aids in Otology. Samuel J. Kopetzky. Laryngoscope, June, 1928, XXXVIII, 416.

The author seems to place considerable value upon the X-ray examination of the mastoid. He feels that the otologists should be able to interpret the findings on radiographic examinations of the mastoid themselves, as they have at their command all the clinical and other laboratory findings. He feels that the roentgenologist who makes a clinical diagnosis from the film is presumptuous unless he is especially trained in otologic pathology. The author goes on to describe the changes that take place in different types of mastoiditis and in infections of the surrounding tissues.

B. C. Cushway, M.D.

Physical and Biological Experiments on Cathode Rays. Walter Schaefer and Ernst Witte. Strahlentherapie, 1929, XXXI, 415.

The authors studied the physical and biological properties of cathode rays. For the first time they deflected with a magnet the cathode rays which were emitted by the tube. This permitted a separate study of the cathode rays and the X-rays, which are, of course, also emitted by a cathode ray tube. All previous experiments had been undertaken with a mixture of cathode and X-rays. They could prove that a considerable amount of X-rays of long and also short wave length leave the tube window. Their tube, running at 95 K.V., 2 ma., emitted at 5 cm. distance through cardboard filter 500 R in 13 seconds, and at 150 K.V., 2 ma., 5 cm. distance 500 R in 5 sec-

onds. They also found that the cathode rays at 150 K.V. do not penetrate into the tissues more than 0.1 mm. The biological effect induced by these rays, which consists in a local leukocytosis, is much larger than the real effect of cathode rays. The skin serves as anticathode during such irradiation and the secondary electrons which are produced are effective in greater depth. The authors confirm the reports of other investigators that cathode rays kill bacteria. There is no therapeutic effect on infected tissue because the cathode rays as used in the experiments did not penetrate more than 0.1 millimeter. The effect of cathode rays on plants and animal tissue is principally the same as that of X-rays. The therapeutic results in cases of lupus and other diseases of the skin following exposure to cathode rays are undoubtedly due to the long and short roentgen rays which are also emitted by the tube. There is no doubt but that the cathode rays because of their slight penetration can be used only in very superficial therapy. Inasmuch as it is also difficult to deflect cathode rays and separate them from the X-rays, the latter are preferable in therapy.

E. A. POHLE, M.D., PH.D.

Cavities in Pulmonary Tuberculosis: Rapid Contraction of Upper and Lower Lobe Cavities with Phrenicectomy. Edgar Mayer and Henry Leetch. Jour. Am. Med. Assn., July 27, 1929, XCIII, 272.

This paper by two members of the Staff at Saranac Lake, New York, first enumerates the indications for phrenicectomy, then outlines the two types of operation and the changes in the lung brought about by them, following up with case reports and numerous roentgenograms showing conditions before and after.

The authors consider the indications for the operation to be, in general:

"1. Unilateral pulmonary tuberculosis, ulcerative and fibrocaseous, not acutely progressive, having a tendency to retraction and scarring, in which pneumothorax is not practicable. This operation is not to be used in place of pneumothorax.

"2. Bilateral tuberculosis which does not admit of the risk of pneumothorax or thoracoplasty, in which extensive disease on one side can be active and on the other side stationary or slightly active; this is more particularly true when the lesion on the less involved side is being fed by an upper lobe cavity of the other lung. (Progressive bilateral tuberculosis may occasionally be an indication but with much less probability of success.)

"3. As a test of the functional capacity of the other lung preceding thoracoplasty.

"4. In recurrent hemoptysis when neither thoracoplasty nor pneumothorax is indicated.

"5. As an adjunct, (*a*) in aiding an incomplete pneumothorax or at the end of pneumothorax treatment when the lung does not re-expand to fill the pleural space; (*b*) in aiding thoracoplasty, generally as a preliminary step to this operation; (*c*) as an adjunct to a partial upper thoracoplasty; (*d*) to aid in obliteration of tuberculous empyema cavities, with or without thoracoplasty, and (*e*) in bronchiectasis or pulmonary gangrene."

The changes brought about consist of "(*a*) compression from below upward, producing diminution of lung volume and corresponding partial immobilization; (*b*) lessened blood and lymph flow, and (*c*) altered nerve supply due not only to excision of the phrenic nerve but also probably to removal or division of other important nerves, notably branches of the vagus or the sympathetics. This idea is supported by the observation in several patients of a persistent tachycardia following the operation. The removal of the piston-like motion of the diaphragm is an important result of the phrenicectomy."

The authors emphasize that "the cases cited here are selected ones and represent unusually favorable results rather than those ordinarily to be expected. Phrenicectomy in a large percentage of our results, in a series of more than forty cases, caused little or no improvement. Further experience should teach us more exact indications for the operation."

M. INGLEHART.